Risk governance in the media age

Alette Eva Opperhuizen

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Printed by: Eikon+

Risicobeleid in het mediatijdperk

Risk Governance in the Media Age

Proefschrift

ter verkrijging van de graad van doctor aan de
Erasmus Universiteit Rotterdam
op gezag van de
rector magnificus

Prof.dr. F.A. van der Duijn Schouten

en volgens besluit van het College voor Promoties.
De openbare verdediging zal plaatsvinden op

vrijdag 9 april 2021 om 10.30 uur

door

Alette Eva Opperhuizen
geboren te Breukelen.

Erasmus University Rotterdam

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Dankwoord

'Geen woorden maar daden' is een Rotterdamse wijze leus waar ik mij graag mee verenig, maar hij gaat niet altijd op. Tijdens mijn promotie waren er veel woorden voor de daden. De woorden gaven invulling aan de uitwisseling van ideeën, brainstormsessies, kritische reflectie, discussies en slap ouwehoeren. Graag wil ik enkele personen hiervoor bedanken.

Mijn promotoren Erik Hans Klijn en Jasper Eshuis. Erik Hans, je bent een promotor die geeft om je PhD-studenten. Dit blijkt uit een bepaalde gedrevenheid. Deze gedrevenheid is voelbaar en – eerlijk is eerlijk – dit vond ik vooral in het begin lastig. Maar hoe verder we het traject doorliepen, hoe beter we afstemming vonden en hoe leuker het werd. Je hebt mij ruimte gelaten en riep me af en toe tot de orde. Bedankt hiervoor. Jasper, je bent een positieve begeleider. Je ziet goed het eindproduct voor ogen en stuurt steeds aan op precisie om die te bereiken. Dit heb ik soms nodig en heeft mij geholpen met het maken van mijn proefschrift. Jasper bedankt daarvoor.

Daarnaast is een deel van mijn proefschrift gebaseerd op interviews. Veel personen binnen Nederland en Italië hebben tijd en ruimte aan mij gegeven om gedachtes te wissen en in gesprek te gaan. Ik wil al mijn respondenten bedanken voor hun inzet, kennis en energie.

Graag wilde ik de bestuurskunde 'verder helpen' en besloot ik mij te verdiepen in de *machine learning*, het heeft geresulteerd in een samenwerking met Kim Schouten en Franciska de Jong (Erasmus Studio). Bedankt voor jullie belangeloze inzet en energie, ik denk dat we mooie (vernieuwende) resultaten hebben bereikt.

Al tijdens mijn promotie hebben Arwin van Buuren en William Voorberg mij een nieuwe kans geboden als onderzoeker in het *Accez* onderzoek naar circulaire economie. Ik wil jullie bedanken voor deze kans en de leuke samenwerking.

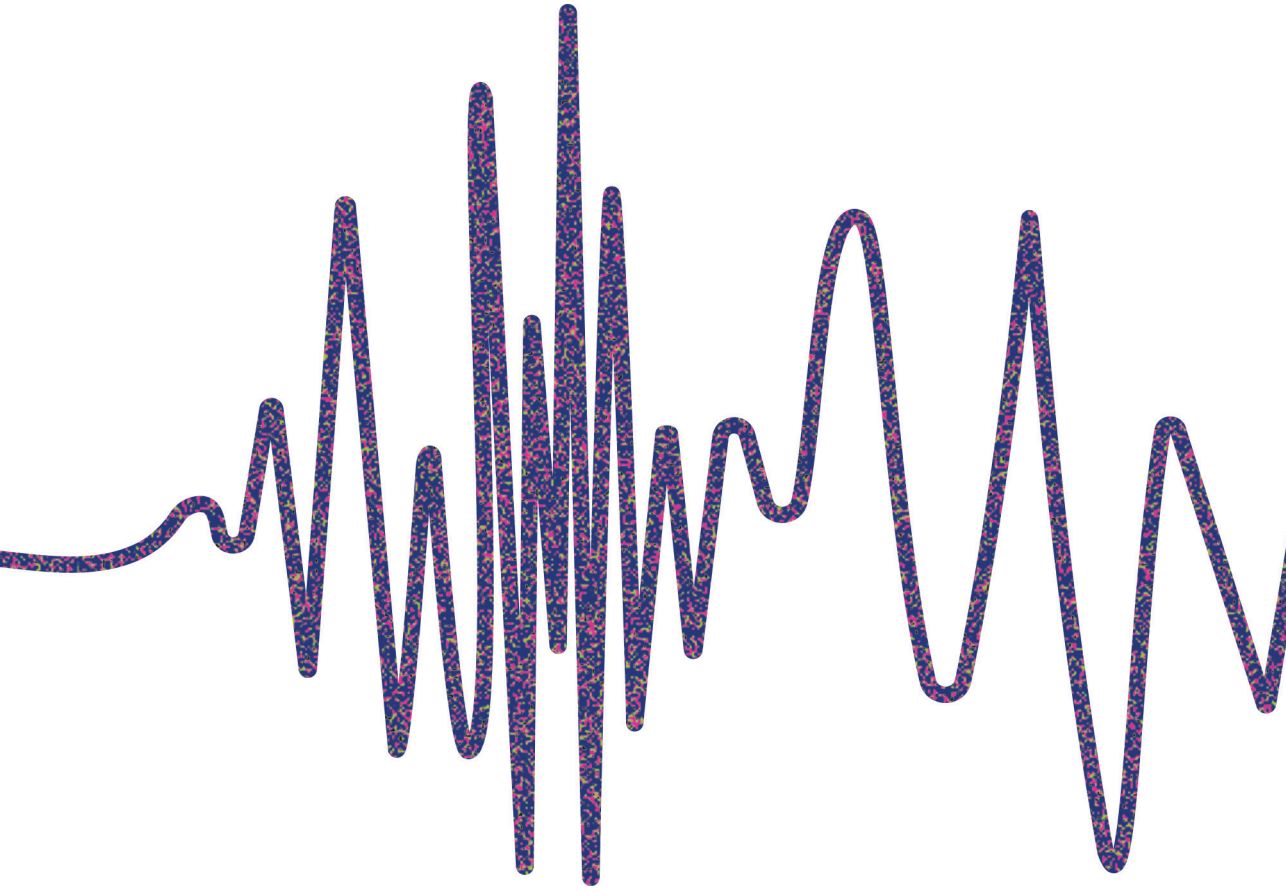
De omgeving waarin ik werk heeft veel invloed op hoe ik mij voel. Ik heb mij heel vaak goed gevoeld in mijn werk mede door de legio aan collega's met wie in een zeer leuke tijd heb gehad in Rotterdam, als PhD'er en als Post-doc'er. Onze levens zijn kort aan elkaar verbonden.

Waarbij we vooral praten, discussiëren en lachen. Zo stond deze tijd vol van leuke activiteiten zoals uitjes, lunchgesprekken en borrels. Collega's bedankt voor al deze gezelligheid.

Met sommige personen (sommige collega's en daarbuiten) heb ik mij dieper verbonden, dit gaat voorbij gezellige lunches en borrels. Zij zetten je aan tot nadenken, bij hen ben je eerlijk en kwetsbaar en door hen voel ik mij verrijkt. Bedankt voor deze kostbaarheid.

Tot slot mijn familie, en hierbij keer ik terug naar ''mijn" leus *'geen woorden maar daden*', we hoeven elkaar niet te vertellen hoe dankbaar we zijn voor elkaars bezit want dat voelen we in elke vezel.

Nijmegen, September 2020



Chapter One: General Introduction

How the valuable gas bubble developed into The Dutch Disease

The Netherlands was given a unique treasure: a tremendous amount of gas, which was found in the late fifties. As a result, a whole generation was warm. Anno 2017, the hangover remains. The money is gone, and the Groningen locals are angry.

Huizinge, 16 August 2012. The earth trembles at 3.6 on the Richter scale. It shakes the province awake, literally and figuratively. The gas production must be stopped, as fast as possible ... Groningen locals often have burn-out, do not feel safe in their own homes, and sleep poorly. Pumped away by the rest of The Netherlands, exploited – that is how they feel. There is a lot to say for that sentiment, and all the money goes to the Dutch State ... The gas money is an ordinary stopgap. How the hell could it get that far?

Algemeen Dagblad – 16 August 2017

To say that rebuilding has been slow would be an understatement

Work in the historical centre only began to gather pace after problems with mismanagement, political wrangling, stifling bureaucracy, and corruption and probes in contractors' links with the mafia. …But those seeking to restore a sense of normality have been irritated by the heavy focus on L'Aquila's problems in some of the media's anniversary coverage. 'They spoke about us in a way that pushed us back 10 years…OK, there is still a lot to do, but over the past decade, we as a community have been trying to exist, to imagine our future and work towards that end.'

The Guardian – 7 April 2019

1.1. Risk governance in the media

The two media quotes above reflect on the role of risk governance in the emerging risk of earthquakes induced by gas drillings in Groningen (The Netherlands) and the aftermath of a natural earthquake in the L'Aquila region in Italy. Although I do not study earthquakes in L'Aquila (2009) in this thesis, this journalist's article gave reason to study the role of media in risk governance in Italy during a series of earthquakes in 2016 in Norcia. In this thesis, I look into the risk processes that take place before, during, and after emerging and catastrophic earthquakes. I am interested in how and when media play a role in the social construction of risk issues and in the media's influence on risk governance processes in emerging technology-induced earthquakes and natural earthquakes. I study this by comparing the Italian case of natural earthquakes with the Dutch case of gas-drilling-induced earthquakes. I do so by investigating the media's roles in constructing the risk as an issue for society and the media's influence on the agenda of risk policy and politics. Both quotes focus on the processes within, and decisions of, the government. However, by studying *how it could get that far* – as one journalist stated – I also address the media's role as an essential factor in the social construction and governance of risk. Therefore, I pay attention to the consequences for risk policy and politics when media attention is lacking.

The media–policy–politics interaction is a big generic issue that is often addressed in the social sciences. Many scholars have focused on how media report on catastrophic events and on the influence of media attention on emergency response, recovery, and the resilience of households, communities, and institutions (e.g. Mileti, 1993; Tierney, Lindell, & Perry, 2013; Walters, Wilkins, & Walters, 1989). Other scientists have focused on media attention on new or emerging risks and the impact that media attention can have on preventive or mitigative actions by governments and other stakeholders (e.g. Ouyang et al., 2017; Quarantelli, 1991; Scanlon et al., 1985; Wilkins, 2005). However, the impact of mediatization – the growing power of media and media logic – on risk governance and society is unknown (Hjarvard, 2013), as also the consequences when journalistic attention is lacking. These issues are less studied, but certainly not less relevant for public risk issues.

Governance networks dealing with risk processes can face challenges, as they are dealing with multi-stakeholder interests, and the

development and consequences of risk issues are, to some extent, unpredictable. Interference by media actors can even increase the complexity of risk governance processes (Klijn et al., 2016). Media might influence the risk governance processes and, therefore, also the extent of preparedness for a risk. One possibility is that the risk is marginalized in the political arena because it is not newsworthy enough for the media to report about it. Or conversely, a new wave in news reports created by journalists may result in mediatized policy and politics. Thus, the role of the media can either facilitate or hinder the risk governance network in responding to risk. The complexity of these interactions is at the centre of this thesis, as risk–media–policy interactions are '*the weakest link in existing studies...*' according to Anita Howarth (2013, p. 1).

In this thesis, I investigate *when* the media report about earthquake risk, thereby providing insights into whether a surfeit or a dearth of journalism can be expected based on the prominence of the risk only. Furthermore, insight is provided into the media's interest in covering risk issues. I also investigate *how* media report on earthquake risk, thereby providing insights into the kinds of topics, biases, and frames that they use. I assume that the when and how elements of the media are integral to the media's influence on when and how society deals with risk issues. The starting point of the thesis is that media can have a significant impact on risk policy and risk governance, and thus on the safety of society.

In this thesis, the influence of media on risk governance of seismic risk is studied with two different cases of earthquake risk. First, in the Dutch case, earthquake risk induced by gas drilling gradually increased over time in frequency and magnitude in the Province of Groningen in The Netherlands. The main issue here is the media's influence on preventive and mitigating measures taken by the government. In this case, I investigate in depth when and how media report the risk of a slowly emerging risk of gas drilling and how this interacts with policy and politics. Second, the Italian case is studied, where communities face strong recurring earthquakes consequent to tectonic movements underground. The main topic in this case is how media influence the emergency response directly after the catastrophe and how this affects risk governance network actors involved in recovery and restoration in the long run. In both cases, the media roles are investigated in light of the risk–media–policy interactions.

1.2. Introduction to the cases

In this section, I first describe in more detail the Dutch case (1.2.1.) and then the Italian case (1.2.2.).

1.2.1. The Dutch case: gas-drilling-induced earthquakes

Gas fields in Groningen, a province in the north-eastern part of The Netherlands, have been among the most critical resources for financing economic activities and welfare growth in the history of the country. By 2018, more than €280 billion had been earned through the technological activity of gas drilling within fewer than seven decades (Vlek, 2018). This is €4 billion a year on average for a population of fewer than 17 million inhabitants – annually approximately €250 per person, with a total of €17,500 for every person born before the start of the gas drilling in the early 1960s. The gas fields were discovered in the ground underneath the Province of Groningen in the late 1950s. At that time, The Netherlands and many other European countries were recovering socially and economically and reconstructing after World War II. However, as a result of two oil crises, stagflation, and the expansion of the welfare state, the Dutch economy lagged behind several other European countries in the 1970s and early 1980s (Delsen, 2017). The discovery of the giant gas fields became a socio-economic and political blessing for the Dutch government. In 1963, the Dutch State and the Dutch Petroleum Company (NAM) started the gas extraction. Since then, the income from gas extraction has accrued mainly to the government and contributes substantially to government revenue. More recently, it accounted for 4.4% (2011), 5.2% (2012), and 5.4% (2013) of Gross National Product (Centraal Bureau voor de Statistiek, 2017). The natural gas revenues enabled the government to invest in infrastructure, education, and the healthcare system. In addition to the benefits for society at large, gas drilling was also beneficial at local level – for instance, by creating employment in a region where unemployment had been high in preceding years. The political attention on gas drilling focused on the way in which the gas reserves could be used in the future for households (heating, cooking), industry, and export (national and international gas supply) (Dutch Safety Board, 2015). Hence, most of the political attention was directed towards how the Dutch economy and welfare could be stimulated and developed through activities and

programmes that were ultimately financed by current and future gas revenues (Dutch Safety Board, 2015).

During the first decades of gas drilling, no adverse effects of the technological activity were observed. However, a few scientists published warnings as far back as the 1970s that future risk could not be excluded (Vlek, 2018). The one-sided and favourable public and political attitude towards gas drilling with a focus on revenues changed slightly in the late 1980s when land subsidence was the first sign of potential adverse side effects of the gas drilling. This was followed by mild earthquakes in the early 1990s (Dutch Safety Board, 2015). Land subsidence and earthquakes then technically entered the political agenda but, in parliamentary debates, politicians continued to focus on revenues and gas supply security (Dutch Safety Board, 2015). This is surprising, as the northern part of The Netherlands did not have a history of seismic risks and unusual natural events.

In advice about gas drilling risks by State Supervision of the Mines (SodM) (In Dutch: *Staatstoezicht op de mijnen*) in January 2013, the main conclusion was that it was necessary to reduce the annual gas extraction in order to prevent stronger earthquakes in the future. However, in this and other reports, SodM also concluded that it remained uncertain what the actual frequency and magnitude of future earthquakes would be and that it was uncertain what would happen if gas drilling stopped completely. Initially, the Dutch Minister of Economic Affairs, who has full political responsibility for the economic exploitation of natural (mining) resources, responded to the SodM advice by initiating more research (Dutch Safety Board, 2015). However, soon after, he decided to reduce the permit for extracting gas from 42 billion cubic meters (bcm)/year to an ultimate 24 bcm/year in September 2016 (Vlek, 2018). Later, a decision was taken to start a programme of complete termination of the gas drilling activities in the Province of Groningen. The Dutch government initiated large national programmes to study the possibilities for transforming the Dutch energy market at large. In addition, the gas policy became integrated into political debates about energy transition and climate change. In March 2019, the Dutch Parliament decided to start a Parliamentary Enquiry (*Parlementaire enquête*) to identify the lack of, or late political responses to, the emergence of earthquake risk in Groningen.

In The Netherlands the gas drilling policy since the 1960 was an intertwined between policy decision at the level of the ministry of Economic Affairs, advice by SodM (part of the same ministry) as the

inspectorate and private companies drilling the gas. The network was coordinated by Maatschappij Groningen, and the Ministry of Economic Affairs, SodM, Energie Beheer Nederland (EBN), Shell, Exxon Mobile and Gas Terra participated and collaborated. SodM's advice about the annual drilling capacity was for decades the foundation for governmental decisions about the gas drilling. Therefore I use SodM reports to indicate policy decision.

1.2.2. The Italian case: catastrophic earthquakes

In the last decade, several strong earthquakes have struck the L'Aquila region of Italy, a region that is geologically prone to earthquakes. An earthquake in L'Aquila in 2009 resulted in 308 deaths, 66,000 homeless people, and 1,500 people injured (Imperiale & Vanclay, 2019; Özerdem & Rufini, 2013). In the aftermath of this earthquake, disaster risk reduction and communication were extensively discussed and criticized (Alexander, 2014).

Although the Italian earthquakes are a natural phenomenon, powerful quakes are predictable to a large extent. Months before the catastrophic event on 6 April 2009, many tremors of increasing magnitude and frequency occurred in the region. However, almost no action was taken in the governance network to prepare for the catastrophic quake (Imperiale & Vanclay, 2019). The lack of action was confirmed in court trials, although the trials themselves turned out to be controversial (Gabrielli & Di Bucci, 2015; Scolobig et al., 2014).

A few years later, history repeated itself. On 24 August 2016, another earthquake (M=6.2) hit parts of Italy, with 297 deaths and 365 people injured (Lavecchia et al., 2016). One month later, from 26 October 2016 onwards, a series of strong earthquakes (M=4.5, M=5.9, and M=6.6) struck three regions: Castelsantangelo sul Nera, Norcia, and Preci. All these earthquakes illustrated that strong earthquakes are a recurring phenomenon in Italy, characterized by severe physical and socio-economic damage. In 2016, Italy was again not adequately prepared for the disruptive earthquakes. It was only *after* the series of earthquakes that measures were taken to monitor the existing building constructions in order to avoid collapses due to a new earthquake (Lopes et al., 2017). As Trifan, Gociman, and Ochinciuc (2019, p. 389) argued, '*unfortunately, the process of recovery and adoption is long and arduous and requires the involvement of authorities and citizens.*'

1.3. Introduction to the research

After decades of gas drilling, the Dutch government and society struggled with the old question that Chauncey Starr addressed in his 1969 paper 'Social benefits versus technological risk: What is society willing to pay for safety?'. At some point, the long period of beneficial gas drilling policy no longer held, and in a short time the policy was disrupted. The rapid change in 2013 followed 60 years of a stable gas policy. The gas policy disruption in The Netherlands resulted in significant changes for future gas production quotas, and measures were taken to compensate for the damage to households and other stakeholders.

The Italian government and society are also struggling with the question: What is society willing to pay for safety? For the L'Aquila and Norcia regions, this struggle is about social benefits versus the cost of a geophysical risk with catastrophic potential. It is unclear whether society is willing to pay only for emergency responses or also for a resilient community living in an earthquake-prone region with a rich history and cultural, touristic, and economic potential.

In the political science and the risk analysis literature, it is argued that media play an important role in how society, including politicians, perceive and respond to risk. These two research fields have studied the role of media in drawing public attention to a policy issue and the regulatory and institutional responses.

In political science, many scientists have analysed sudden changes in political attention on an issue after a long period of stable policies. Downs' (1972) issue attention cycle, Kingdon's (1984) theory of windows of opportunity, and Schattsschneider's (1975) earlier work on conflict expansion are often used as foundations for research in this field. On the basis of a longitudinal analysis of various policy and political issues, Baumgartner and Jones (2009) formulated their punctuated equilibrium theory, stating that the governance of risk issues shows sudden major shifts in risk-benefit policies after long periods of equilibria, a phenomenon also observed for gas drilling in The Netherlands. The mobilization of a counter-voice plays a vital force in this policy disruption, according to Baumgartner and Jones. From this theoretical perspective, media play an essential role, as they can spread counter mobilization in society (Downey & Fenton, 2003). However, Baumgartner and Jones did not further investigate the roles of the media in detail in the disjoint disruption of policies in the various cases that they studied.

In risk analysis science, there is a strong focus on societal responses to physical risks and risk events. The social amplification of risk framework (SARF), devised by Kasperson et al. (1988), is often applied and developed *'to describe the various dynamic social processes underlying risk perception and response in society*' (Kasperson et al., 2003, p. 13). In this framework, the impact of a risk on society is not particularly dependent on the risk assessment or the actual prominence of the risk but mainly on psychological, sociological, institutional, and cultural processes (Kasperson et al., 1988). Media play an important role, as, by filtering and framing the multitude of subtopics of the risk and its negative consequences for society, they can intensify or weaken signals of the risk that individuals and groups receive (Kasperson, 2005; Pidgeon, Kasperson, & Slovic, 2003). SARF scholars argue that media and other social stations can create secondary impacts on society, known as ripple effects (e.g. economic losses or stigmatization of technologies), and influence political decisions (Flynn, 2003; Kasperson et al., 1988). Although media play an essential role, Kasperson et al. did not study or describe this role in more detail. Right after its first publication, SARF was criticized for the role ascribed to media in the framework (Binder et al., 2015; Rip, 1988).

Reporting about public safety issues is often also seen as a democratic function of the media (Bakir, 2010; Schudson, 2009). From this democratic perspective, media should serve as a watchdog and warn or correct political actors (Aalberg & Cuuran, 2012; Entman, 2005; Norris & Odugbemi, 2010). They may either stimulate political actors to take preventive measures when possible or facilitate risk governance networks to be prepared when the occurrence of the hazardous event cannot be prevented. Media can put pressure on governments and governance networks to hold them accountable for safety (e.g. Bovens, 2007; McCubbins & Schwartz, 1984; Strøm, 2000). With their presence, media already enable a self-correcting effect in society, and they may provide a moral compass for governance actors and remind them of their representation task (van Kersbergen & van Waarden, 2004). Conversely, a lack of journalistic attention on a risk issue means a failure to play a role as a democratic watchdog. A lack of media attention may cause unawareness among citizens and politicians and attenuate a potentially serious risk for society. However, media outlets are social units that apply interpretative patterns according to the rules of their home organization or group. These rules are derived from professional standards, sometimes referred to as media logic (Altheide & Snow,

1979, 1992; Bennett, 2009). Media logic entails media selecting and classifying items as newsworthy and creating news items for their consumers. The often conflict-focused and negative biases and frames in media reporting may interfere with the debates in politics (e.g. Esser & Strömbäck, 2014; Korthagen & Van Meerkerk, 2014; Manin, 1997). Vasterman, Yzermans, and Dirkzwager (2005) even argue not only that the event shapes media reporting and, consequently, decision making, but also that a media hype is a phenomenon in itself. It can completely change the character of the message being communicated and impact society. Kepplinger (2018) also argues that applying media logic to an issue may cause the character of the news to change dramatically, actually creating a new mediatized issue. '*They [the journalists] are themselves a part of the event that they and their colleagues are reporting about*' (Kepplinger, 2018, p. 14). Mediatized news plays a critical role in the theoretical mediatization of politics framework (Mazzoleni & Splendore, 2015). Consequently, there might be severe reality misperceptions in society and among politicians, and these misperceptions in media can influence decision making in politics and result in under- or over-preparedness in risk governance structures. According to Rip (1988), responding too much to a small risk issue, or not enough to a significant risk, can be very costly for society.

Baumgartner and Jones (2009) have argued that changes in media attention, both in volume of publication and in content, play a critical role in policy disruption. However, they do not provide details on when and how media influence policy disruption, nor do they address the question of the role that media play, or do not play, in the long period of policy stability. The same questions can be raised for SARF: when and how do media start to generate ripples that influence policy and politics? Binder et al. (2015) argue that changes in newsworthiness play a critical role in the media's amplification or attenuation of the importance of a risk issue in society. A lack of attention by the media about a public risk – because it lacks newsworthiness – may cause harm to groups of citizens. It may result in underpreparedness for future risk events. Not only policy decisions but also institutional rules and changes in governance structure can be the result of public attention orchestrated by media (Renn, 2009). Media's role in applying their own media logic rules is further investigated in this thesis. It is an important guide in the process that generates forces that push risk policies away from the status quo, with potentially significant consequences for risk governance.

1.4. Main and subsidiary research questions

Governance dealing with *the risk–media–policy* relationship is at the heart of this thesis. The overall research aim is to provide more insight into the role that media play in risk governance and its dynamics. Therefore, the central research question is:

> ***How and when do media play a role in the social construction of risk issues, and what is the media's influence on risk governance processes of emerging technology-induced earthquakes and natural earthquakes?***

This overall research question translates into more specific subsidiary research questions.

Goffman (1974), one of the earliest scientists to study framing issues in the media, argued that reframing can occur in media at any time when incongruent information becomes available and new meaningful elements arise about the situation or issue. This raises the question of what constitutes incongruent information and meaningful elements, leading to the first subsidiary question:

> **1. When and how do media frame and reframe an emerging risk issue over time?**

In the scientific literature, there is debate about how and how strongly media attention can impact the development of the political and policy agenda (e.g. Breakwell & Barnett, 2003; Van Aelst et al., 2014; Walgrave & Van Aelst, 2006). Therefore, the second subsidiary question is:

> **2. What is the dynamic between media, political, and policy agendas?**

From the literature, it is clear that media often have their logic, characterized by certain biases and the use of particular framing elements and sentiments (e.g. Entman, 2007; Patterson, 2000; Semetko & Valkenburg, 2000). Framing influences the risk attitudes of politicians and other audiences, with either positive or negative consequences for risk governance networks' perceptions and activities. Therefore, I want to find answers to the third subsidiary question:

3. How is the news media's role in the risk governance decision making process perceived by network actors?

Finally, in the literature about risk management, much attention is given to risk assessment, risk communication, crisis management, and other elements of risk governance related to risk events. However, little attention has focused on the preparedness of risk governance networks before events happen. Media may not be interested in risk preparedness as such, but what does that mean for the risk preparedness of the network? This is at the heart of the last subsidiary question:

4. What factors influence the risk preparedness/underpreparedness of governance actors and networks?

1.5. Methodology and data collection

A comparative case study is conducted (Yin, 1984); this entails studying only two cases in detail to better understand their complexity (Blatter & Haverland, 2012). The Italian and Dutch cases are different, but also show notable similarities. First, the earthquakes in both cases are recurring and are, at least to some extent, predictable and assessable. This should allow governments and other actors in the governance network to prepare for the adverse consequences and even take preventive measures. Significant differences in the cases lie in the origin of the earthquake risks themselves. In the Dutch case, many tremors occur, each of which causes relatively limited damage (so far); no direct fatalities have been registered. In Italy, the infrequent powerful earthquakes have catastrophic effects, and there is a risk of many fatalities. Moreover, the Dutch earthquakes result from human technological activities, whereas the Italian earthquakes result from tectonic action underground. Furthermore, the cultural, political, and socio-economic situations in Italy and The Netherlands are different. The consequence of the research design is that the results will not lead to direct generalizability (Hufen & Koppenjan, 2015). However, they may generate meaningful new insights about the governance of emerging risk in the media age.

This research uses two different types of data sources. In Chapters Three, Four, and Five, the focus is on content in media reporting about earthquake risks in The Netherlands, discussions in Parliament, and

reporting by a governmental agency. I conducted a longitudinal content and sentiment analysis by applying supervised machine learning, a method that can automatically detect patterns in data based on a learning algorithm interoperating with the social scientist. In Chapters Six and Seven, I focus on a double international case study of The Netherlands and Italy with a different methodology. In these chapters, I draw on semi-structured interviews and qualitative coding analysis.

1.6. The relevance of this thesis

In this section, I address the theoretical relevance (1.6.1.), the practical relevance (1.6.2.), and finally the methodological relevance (1.6.3) of this thesis.

1.6.1. Theoretical relevance

This study aims to make an academic contribution to existing theories and concepts in various ways. First, this thesis contributes to the risk analysis literature, as this study provides insights about the media's role in the social construction of risk and the influence on risk governance, especially when media attention is lacking.

Second, it contributes to the media and communication literature about stability and changes in news media reporting over time. In their overview of communication and media studies encompassing changes over time, Stanyer and Mihelj (2016) concluded that very few studies focus on trend mapping, on temporal comparison, and on turning points in communication. This thesis contributes to all three aspects of longitudinal studies mentioned by Stanyer and Mihelj. With Chapters Three, Four, and Five, I hope that this thesis contributes to insights into the background of stability, changes, and critical junctures of news media reporting.

Third, this thesis contributes to the literature on political and public administration science, because this study generates more detailed insights about media's role in risk policies and risk preparedness, as well on the dynamic interaction between media, policy, and politics.

Several studies from the fields of political science, media and communication science, and risk governance published around, or even before, the 1980–1990s are the foundation of this thesis. Over the last few decades, in many publications, the foundational ideas about framing, issue attention, agenda setting, newsworthiness, conflict

expansion, risk perception, social amplification, and risk governance have been further developed. Many studies report elements that are relevant for understanding the dynamic interaction between risk as a social construct, media attention on the risk issue, and governmental response. For example, various scholars have published on media framing about risk events (e.g. Allan, Adam, & Carter, 2000; Altheide & Snow, 1979; Gamson & Modigliani, 1989). Others have reported on media as a source of risk-related information and warnings (e.g. Ledingham & Walters, 1989; Mileti & Fitzpatrick, 1993; Perry, Lindell, & Tierney, 2001). In addition, emergency preparedness and response by the media to calamities and catastrophes have also been studied for various cases (e.g. Barnes et al., 2008; Merchant, Elmer, & Lurie, 2011; Quarantelli, 1991).

However, Perry et al. (2001) concluded that knowledge is still seriously lacking in large-scale, systematic, comparative research on the role of media in risk. They called for empirical evidence of the theoretical perspectives on public risk, media attention, and governance responses – a call that was later echoed by others (Wardman & Löfstedt, 2018; Wirz et al., 2018). In addition, Howard (2013) argued that media and policy interaction is essential in risk debates, and she notes that this interaction has hardly received attention from risk scholars. Wolfe et al. (2013) also argued that the role of news media was studied mainly concerning political processes and less about decision making processes.

In this thesis, I try to respond to these calls for large-scale systematic research in an attempt to offer a better-integrated understanding of the role of media in the attenuation and amplification of public risk. I use the SARF as the primary conceptual model – not to provide proof, but as a model that links realistic or perceived risks to risk governance. News media, particularly newspapers, are at the centre of the thesis. How media create news and apply media logic, on the one hand, and how they fulfil their democratic function, on the other hand, is a critical issue in this thesis (Bakir, 2010; Bandura, 2001).

1.6.2. Practical relevance

A quote from senior Dutch politician *Alexander Pechtold* in his farewell letter on 9 October 2018: *'The hyper reactions between media reports and our (political) agenda hold us in the present and obstruct our responsibility for the longer term.'*

The former parliamentary leader of the Democratic Party (known as D66) and member of the House of Representatives addressed the

development of the relation between media, politics, and policy critically. He argued that there is a 'hyper relation' forcing politicians to focus only on the hype-of-the-day. He added that the way media play a role in our democracy undermines long-term policies and affects our values negatively. By focusing on the interaction between media, risk, and politics, this study contributes to public administration practice in three ways.

First, it provides insights into what media judge as newsworthy about public risks and the incongruent and meaningful signals that trigger media to start or change their reporting about an issue (Goffman, 1974). The study also illustrates how media apply their particular frames and how this may contribute to the amplification of risk or even create media hypes and media-created realities. On the other hand, the study addresses the consequences for safety in society when media miss, or fail to report on, an emerging public risk.

Second, the study aims to provide support to governmental and scientific institutions, agencies, and authorities to apply newsworthy frames when they want to use media to socially amplify risk signals and make these signals more salient to citizens, policymakers, and politicians. Technical information is often not newsworthy, and the independence and responsibilities of both media and the institutions usually do not enable a smooth flow of risk information to the general public. On the other hand, media that want to report about risk events often lack knowledge and information from reliable sources. Governmental agencies and institutions seem to underestimate how media may be used strategically to communicate risk-related information to the general public. Risk governance actors can operate strategically concerning the media, even though media have their particular logic and responsibilities. Findings about media logics may help risk governance network actors to understand better the mediatized transmission of risk information. This research tries to provide a more general level of understanding with regard to the relationship between media and the conveying of information about public risks to society, thereby allowing public organizations to improve their media management and communication.

The last practical contribution is that mechanisms relating to policy stability and significant disruptions may not be applicable only in the case of earthquake risk. Practitioners in other fields may take notice of the outcome of the study. In the Dutch television programme *Medialogica* (2018), numerous examples are available (e.g. #meToo or

radicalization of Turkish youngsters), in which the findings from this study can be recognized in other contexts. It shows that the interaction between media, risk, and policy is standard. In line with Perry et al. (2001), I think that science and practice should continue to revisit questions that are critical for our understanding of emergency preparation and response.

1.6.3. Methodological relevance

In Chapters Three, Four, and Five, supervised machine learning (SML) is applied, a methodology based on the early work of Sebastiani (2002). This relatively new technique enables the handling of large amounts of digitalized data and provides opportunities to focus on more extended periods (Chong & Druckman, 2010). More automatic methods of data analysis are becoming increasingly important and available in the social sciences (García-Marín & Calatrava, 2018). According to Burscher et al. (2014, p. 42), *'comprehensive content analysis [with SML] of mass media allows investigation of news framing and its effects over the long term and also allows more nuanced, conditional, and comparative research. It is relevant because more and more media content is becoming available digitally.'*

The first methodological contribution of this study is to show that the application of SML is possible and can be an essential tool for the content analysis of extensive digital databases, which can include different sources, including transcripts of parliamentary debates. Although SML techniques may, at present, still face major challenges, they are already useful for the social scientist (García-Marín & Calatrava, 2018).

The second methodological contribution is that SML may provide an alternative for human coding in content analysis studies. Human coding is still the golden standard but often suffers from perception and interpretation biases of the coders and weaknesses in the coding schemes. SML still requires human coding in order to help the machine to learn from a training dataset. However, after that, the machine can handle big datasets with human supervision. In this thesis, I did not investigate the potential use of unsupervised machine learning, as was recently done by Walter and Ophir (2019) for example, in which human coding is no longer required.

1.7. Outline of this thesis

This chapter started with an introduction to the two case studies, the aims and objectives, the research questions, and the methodology used. In Chapter Two, theoretical concepts are introduced. The concept of risk is addressed with the emphasis on risk as a social construct. Chapter Three, presents a content analysis of newspaper articles about the Dutch gas-drilling case are presented and discussed to identify the dynamics of subtopics. Chapter Four presents sentiments used by journalists over long periods. In Chapter Five, the results of the media analysis are compared with the subtopics extracted from the content of political debates and regulatory policy documents in an attempt to unravel the dynamics between media, political, and policy agendas in the case of public risk. In Chapter Six, I use the outcome of interviews held in The Netherlands and Italy with network actors and focus on how they perceive the role of media in risk governance. Thus, in Chapters Three and Four, the focus is on the role of media in the social construction of risk. In Chapters Five and Six, the focus is on the influence of media on risk governance in the response to socially constructed risk. In Chapter Seven, the focus is on the underpreparedness of the governance network when media attention is absent. Finally, I bring the results from the content analysis studies (Chapters Three–Five) and the interview studies (Chapters Six and Seven) together in Chapter Eight, formulate answers to the research questions, and discuss broader implications as well as limitations of the study.

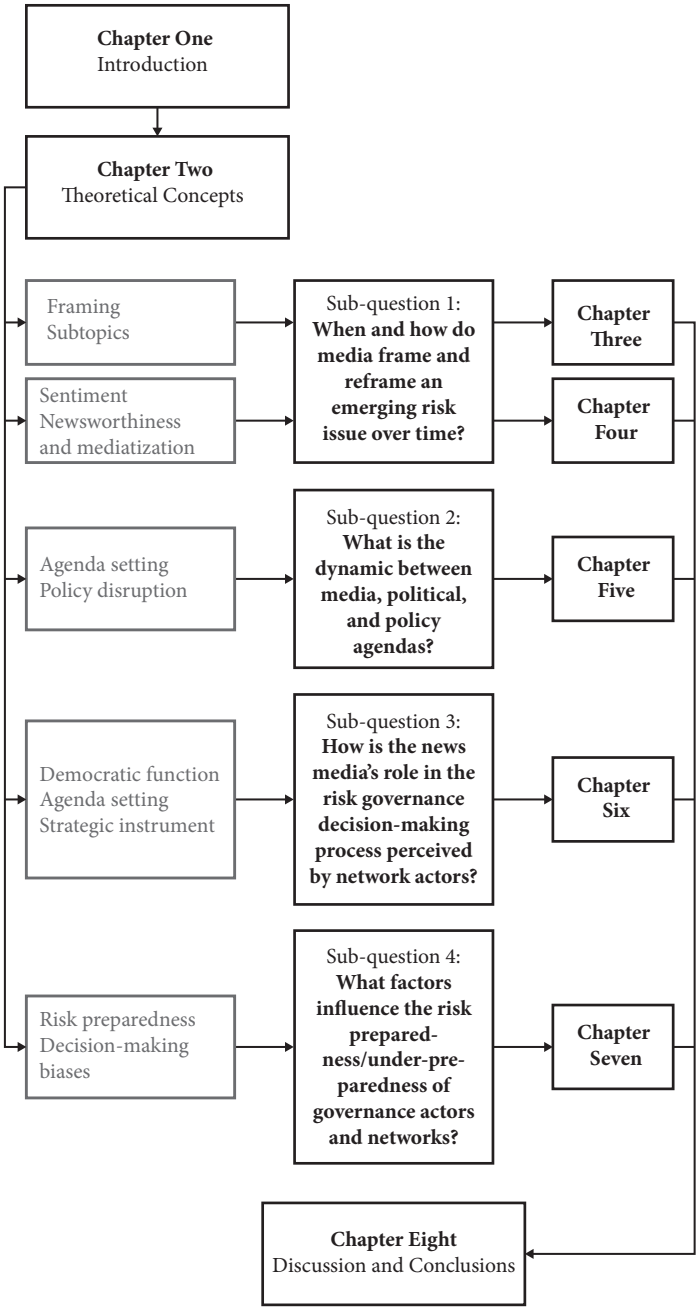
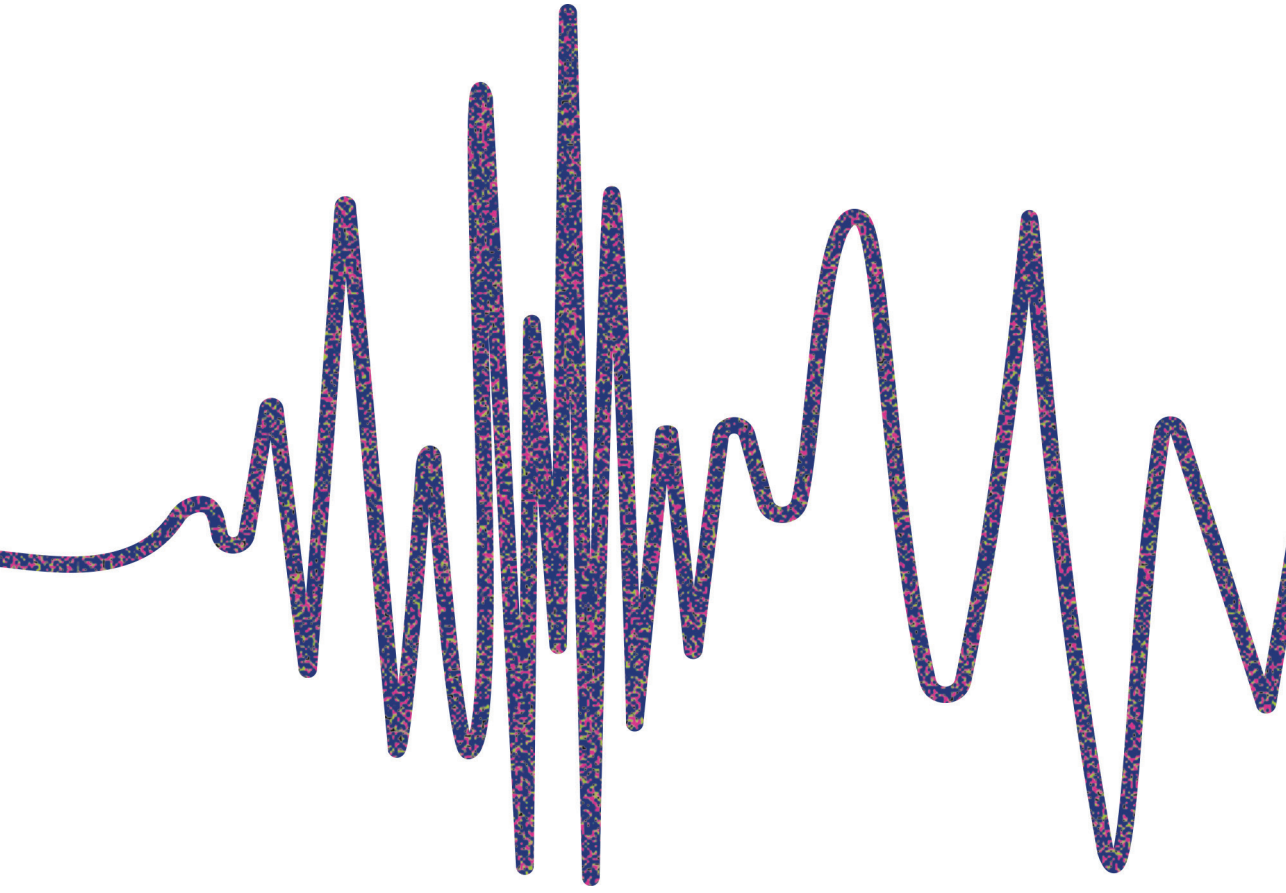


Figure 1.1: Graphic outline of thesis



Chapter Two: Theoretical background

In this theoretical chapter, I first define risk and introduce some main theoretical concepts, such as perception, attitudes, awareness, and risk signals (section 2.1). Second, I introduce the concept of the social construction of risk and describe societal responses to risk signals about emerging or catastrophic events, paying special attention to the social amplification of risk framework (section 2.2). Third, I define the concepts risk governance and risk preparedness, and describe the processes and actions in policy and politics (section 2.3). Then, I switch the focus to the media and give a brief overview of the literature about media influence on the social construction of risk (section 2.4). This is followed by theories and models about the influence of media on policy and politics, with particular attention on media logic and the mediatization of policy and politics (section 2.5). Finally, I bring the theoretical backgrounds about risk, media, and governance together in section 2.6.

2.1. Risk and society

'*The definition of risk matters,*' Paul Slovic argued in his contribution to the annual meeting of the Society for Risk Analysis in December 2017. That it matters is apparent from an ongoing debate in theory and practice about what risk actually comprises, in particular about the objectivity of the threat and/or harm and the criteria that are applicable for risk analysis (Aven & Renn, 2009).

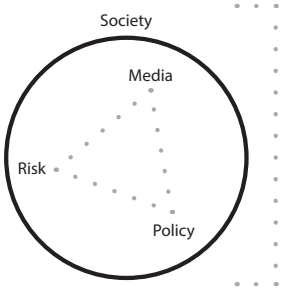


Figure 2.1: Media, risk, policy in society

In this thesis, Eugene Rosa's definition of risk is applied.

Eugene Rosa's definition of risk:
Risk is '*…a situation or event where something of human value (including humans themselves) has been put at stake and where the outcome is uncertain.*' (Rosa, 1998, p. 28)

Situations or events are portrayed through various signals. In the literature, risk signals are defined as '*messages about a hazard or hazardous event that affect people's perceptions about the seriousness or manageability of risk*" (Kasperson et al., 1988, p 17). Risk signals entail, for example, headlines and images in the news, symbols, metaphors, editorials, and cartoons. These signals interact with a wide range of psychological, social, and institutional processes in a way that amplifies or attenuates perception of risk and its manageability (Kasperson et al., 2003). Risk signals can be the result of physical harm but can also be the result of interpretations. *´These interpretations provide rules of how to select, order, and often explain signals from the physical world*' (Renn et al., 1992, p. 140).

In line with Rosa's definition, risk assessment, risk communication, risk management, and risk governance all deal with human values that are at stake. Examples of human values that can be endangered are human health, economic activity, private property, cultural heritage, trust, social structure, and many other issues of human wellbeing and societal interest. The likelihood or probability of human values being adversely affected varies between situations and can be perceived differently by every human stakeholder involved (Aven & Renn, 2009).

2.2. The social construction of risk

In this section, the literature covering the different aspects of the social construction of risk is presented. I first address risk signals and their influence on perception and attitudes in society. I then address social amplification of risk signals. Lastly, I present the risk signals that are important for the main topic of this thesis: natural and human-induced earthquakes.

2.2.1. Risk signals influence perception and attitude

Social responses to risk events are based on citizens' direct experiences, or indirectly on risk signals from the news media or other risk signal stations (Pidgeon, Kasperson, & Slovic, 2003). Most citizens do not usually have direct experiences of risk events and thus depend on risk signals provided by others (Pidgeon et al., 2003). Individuals or groups evaluate and interpret the risk signals based on their own social values, perceptions, and attitudes (Kasperson, Golding, & Tuler, 1992). The interpretations of the individuals or groups will further be communicated

to others and become risk signals that diffuse into society at large, according to Turner and Pidgeon (1997), who argue that this development of public opinion about a risk issue can be time consuming.

The source of risk signals strongly influences how individuals and groups perceive the signals and respond to them (Kasperson et al., 2003). Risk attitudes and perceptions can be influenced by the content of the messages – *what* is communicated (e.g. Fischhoff, 1995; Frewer & Miles, 2003; Chryssochoidis, Strada, & Krystallis, 2009). Risk attitudes and perceptions are also influenced by trust in the source communicating it – *who* is communicating (e.g. Renn & Levine, 1991; Slovic, Flynn, & Gregory, 1994; Frewer, Scholderer, & Bredahl, 2003).

Risk perceptions are vital for public opinion, policy decision making processes, and risk governance. However, laypeople's risk perceptions often do not align with risk assessment outcomes from experts like scientists (McComas et al., 2006). Low risk, as assessed by experts, may be perceived as a serious threat by laypeople and decision makers (amplification of risk). High risk, assessed by experts, may receive little attention in society, leading to under-responses in politics and policy (attenuation of risk) (Kasperson et al., 1988; Renn, 2009; Fjaeren & Aven, 2019). The decisions and actions taken by risk governance actors (governmental and non-governmental) are founded mainly on these actors' own perceptions (McGuire & Agranoff, 2011). These perceptions are influenced by the societal attention paid to the risk.

2.2.2. Social amplification of risk signals

Similar to risk perception, risk attitude is not a static phenomenon (Slovic, 2000). Both can change over time at the level of individuals, groups, and communities, and are the foundation of the construction of risk in society.. Media attention can influence risk awareness, perception, and attitudes in society, for example as shown for the risk of wildfires (Jacobson, Monroe, & Marynowski, 2001), climate change (Sampei & Aoyagi-Usui, 2009), and nanotechnology (Cacciatore, Scheufele, & Corley, 2011). Fjaeran and Aven (2019) argue that risk signals from media influence societal and political responses in the short run and sometimes influence risk governance and socioeconomic processes in the long run. The link between risk and political and regulatory policy agendas is reflected in the social amplification risk framework (SARF). Techno-scientific assessments of, social experience (perception and awareness) of, and societal responses (socioeconomic, political, policy, governance) to, risk are integrated into SARF (Kasperson et al., 1988).

SARF is a useful framework because it helps to elucidate the impact of risk information on society (Duckett & Busby, 2013). SARF was initially developed to help to explain why a small techno-scientific risk sometimes receives massive societal attention and response.

SARF entails two stages for the construction of risk in society, the *social amplification* stage during which information about the situation or event is transformed and socially constructed, and the *ripple effects* stage, in which response mechanisms towards the socially constructed risk are developed in society, the economy, and politics (Kasperson et al., 1988). In the amplification stage, two extreme outcomes can be anticipated:

1. A real hazardous event or risk issue that is assessed and classified as a high risk by experts receives little public attention: this is referred to as *attenuation* of the risk;
2. A real hazardous event or risk issue is classified as a low risk by experts but receives much public attention: this is referred to as *amplification* of the risk (Kasperson et al., 1988).

Critically, in the amplification stage, signals of events thus may or may not raise awareness that human values are at stake (Rosa, 1998, 2003), be adopted by individuals, groups, or society, and influence attitudes (Rip, 1988). Objective or perceived subjective risk must thus first obtain signal value for citizens (Wardman & Löfstedt, 2018) before it can be designated as significant for society (Kasperson et al., 1988).

SARF focuses on the structural roles and dynamics of risk signals diffusing towards the broader public through amplification stations. These amplification stations can be individuals, groups, and organizations, as well as social media and news media such as newspapers. Kasperson et al. (1988) consider the following steps crucial for the primary impact of amplification stations of situations and events:

1. Filtering and decoding risk signals;
2. Processing risk information by adding meaning to the signals;
3. Adding social value to the risk signals in order to draw implications for management and policy;
4. Interacting with cultural and peer groups to interpret and validate risk signals, formulating behavioural intentions to tolerate or to take action against the risk or the risk managers;
5. Engaging in group or individual actions to accept the risk, tolerate the risk, or take action to change the risk.

During the production or the transmission of the risk signals, each station can add biases to reframe the message; this may result in social attenuation or amplification of the perceived risk, which determines the social construction of the risk. A risk can particularly be amplified when emotional elements are added, such as anger, fear, conflict, trust, and compassion (Renn, 1992, 2009; Slovic, 2000).

The primary effects (those that can be directly related to the event) in the SARF amplification stage can be followed by secondary impacts (those that can be indirectly related to the event) in society. In this second stage, risk as a social construct *ripples* towards others in society, like politics, the economy, or the risk governance network. Regardless of the prominence of the risk, others are affected and perceive consequences (Wirz et al., 2018). Ripple effects can stimulate political and risk-governance action and lead to an organizational response and policy changes (Kasperson et al., 1988). On the other hand, a failure to create ripples may lead to attenuation, resulting in a lack of risk governance action (Rip, 1988). It should be noted that attenuation processes have been studied less than amplification processes, according to Binder et al. (2015).

2.2.3. Risk signals of natural and human-induced risks

A study by Trumbo (1996) showed that the interpretation of risk signals firmly determines individuals' risk awareness and perception. Citizens' perceptions, including those of politicians, are to some extent systematic and can be predicted based on mental models as well as on elements of the risk situation such as 1. voluntariness, 2. controllability, 3. catastrophic potential, 4. scientific understanding, 5. effects on future generations, 6. equity, and 7. dread (Slovic, 2000). However, risks can also be perceived differently by individuals, as people are prone to subjective cognitive and cultural elements (Taarup-Esbensen, 2019). Education level, familiarity with risks, and other factors also cause differences in risk attitudes within society (Slovic, 2000). These factors complicate the predictability of people's individual risk perception.

The abovementioned elements of risk can be used to predict the risk awareness and individual perception of earthquake risk to some extent and therefore allow for preventative measures and risk preparation (Slovic, Fischhoff, & Lichtenstein, 1981). Many regions in the world face a geophysical risk of earthquakes. In Italy, the L'Aquila and Norcia regions have a long history of such a risk, facing involuntary events with catastrophic potential that cause dread in communities. Although

the recurring event cannot be controlled, and the communities in those regions are familiar with the risk, the adverse consequences can be limited, and equity can, to some extent, be protected by risk governance actions. Furthermore, the occurrence of significant events can be predicted to a large extent because there is a good understanding of the nature of the earthquakes, and early warning methods are available for risk assessors and risk managers (Zollo et al., 2009).

Besides tectonic movement, the application of large-scale technologies in the energy sector, such a gas drilling, can also result in the generation of predictable earthquakes. However, communities living in the environs of the drilling facilities may not have a seismic history, as is the case in the northern province of The Netherlands. The benefits – e.g. household energy and tax revenues – of large-scale technologies such as gas drilling accrue to the general public, although citizens, in general, may hardly be aware of this (Arlt & Wolling, 2016). Binder et al. (2015) argue that individuals living in the proximity of the technological facilities can experience the impact of the risk in daily life. Local citizens may thus differ significantly from the general population in their risk/benefit attitude, as the latter are only indirectly informed by media (Ho, Scheufele, & Corley, 2013). In such cases, risk awareness is highly dependent on media paying attention to the issue, as most citizens do not have direct experience with the risk. This is particularly important in cases where the risks and benefits of technological activities are distributed among citizens geographically rather than homogeneously (Kasperson et al., 1992; Hung & Wang, 2011). Whereas some local communities face elevated risk, some others and the general population profit substantially from the benefits, and this introduces inequality and value conflicts (e.g. Alhakami & Slovic, 1994; Slovic, 2010; Finucane et al., 2000). Local communities may perceive not only the earthquakes as an involuntary risk, but also the gas drilling in its own right. Gas drilling decisions can influence the earthquake risk, but such decisions are not taken by those who are facing the risk, who are afraid of the future catastrophic consequences of the risk. Moreover, local risk events will raise low or no public awareness to generate political impact unless the media communicate about it (Bakir, 2010).

2.3. Risk governance

In this section, the literature on risk governance and risk preparedness is first presented. I then address the risk governance of an emerging risk – where risk information changes over time, limiting the options for risk preparedness – and I conclude with risk governance in the light of the punctuated equilibrium theory in section 2.3.3.

2.3.1. Risk governance and preparedness

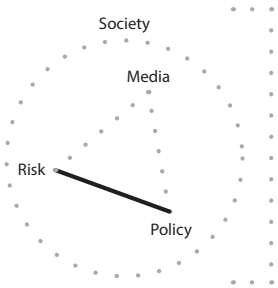


Figure 2.2: Theory of risk–policy interaction

Society determines the extent to which it accepts risks. Decision making about what level of risk is acceptable is not a technical question but a value question (e.g. Covello, Sandman, & Slovic, 1988; Sjöberg, 2000; Hansson, 2003). Politicians and governmental administrative bodies play a dominant role in protecting citizens against risks. The risk governance actors focus on risk prevention or on care and cure after hazardous events have taken place. However, not only governmental bodies are involved in risk management. Other societal actors, including media, also take part in institutional structures and socio-political processes concerning risk. Risk governance networks aim to prevent and reduce the negative impacts of risks and events (Klinke & Renn, 2019).

> **Risk governance** '*marks out institutional structures and socio-political processes that guide and restrain collective activities of a group, society, or international community from influencing or directing the course of events or people's behavior when dealing with risk issues. Risk governance aims to prevent and reduce the negative impacts of risks or risk events.*' (Klinke & Renn, 2019, p. 2)

Risk governance entails various risk management processes that should not be isolated from one another (Lindell et al., 2013):

1. *Risk prevention or mitigation*, actions by governance actors before a hazardous event takes place, primarily through measures that reduce casualties (e.g. setting norms and standards, production limits, land-use regulations, or information to the public);
2. *Emergency preparedness*, actions undertaken before the occurrence of a hazardous event or events, thereby enabling communities to respond actively when the hazardous event manifests. Emergency preparedness is especially important when the risk events are recurring. In both stages, the governance network can use media to inform others in society about the policy actions and plans made (e.g. hospital facilities or training of rescue workers);
3. *Emergency response*, actions directly after a hazardous event takes place, for example to reduce the number of victims and the amount of damage and disruption;
4. *Recovery*, actions taken to repair, rebuild, and reconstruct damaged, and restore disrupted, communities' social routines and economic activities.

> **Risk preparedness** aims to build the capacity of nations and communities to be better prepared and mitigate the natural disaster risk in their region. (UNESCO, 2020)

Preparedness encompasses activities as diverse as risk analysis, preparedness planning, resource allocation, training and exercises, deployment in real events, and feedback and learning (Baker & Ludwig, 2016; Njå, 1997; Lindell et al., 2013).

Meyer and Kunreuther (2017) studied risk preparedness and identified patterns resulting in the underpreparedness of humans and organizations. They argue that underpreparedness of risk government systems and risk governance networks is very common. According to them, humans fail to protect themselves, and they explain this by several psychological biases that underlie decision making. According to Meyers and Kunreuther, factors that underly risk preparedness include: 1. the tendency to focus on short time horizons (myopia), 2. not learning from the past (amnesia), 3. underestimating the likelihood of future events (optimism), 4. maintaining the status quo (inertia),

5. selecting only a subset of relevant facts (simplification), and 6. the tendency to follow others' decisions (herding). Especially in the case of recurring events such as earthquakes, these biases may play an essential role in risk management.

2.3.2. Governance of emerging risk of beneficial technologies

Risk assessment of technologies nowadays takes place before introduction and application in society and is usually focused on prevention. Although the best available knowledge may be used in this risk assessment, serious uncertainties often remain for decision makers (Flage et al., 2014; Aven, 2013). Therefore, risk management also pays attention to emergency plans. Issues such as the siting of nuclear power plants (Vijayan et al., 2013), nuclear waste disposal sites (Bertsch et al., 2007), and the generation of energy by wind turbines (Garcia & Bruschi, 2016) have been the subject of many studies. The siting of hazardous facilities is very technical and difficult to communicate because of the uncertainty of elements in the risk assessment. This calls for '*new ways of arranging relationships between knowledge producers and other societal parties in interaction processes*' in future governance networks, as stressed by Klijn and Koppenjan (2012, p. 598).

Public ownership by the government of assessment and management of large-scale public risk has a long history and is widespread. This does not mean that before the introduction of new technologies all potential hazards are known and that the risks are adequately assessed. New risks associated with technology may emerge over time, for example in shale gas and oil extraction by hydraulic fractioning (Thomas et al., 2017). When uncertainties are accepted, and the outcomes of the risk assessment are deemed acceptably safe, new technologies may be widely applied.

Technological activities are often located in a specific region of a country. Halfacre, Matheny, and Rosenbaum (2000) reported that risky facilities are often located in low-income rural areas with limited access to centralized authorities, which are the decision makers. Consequently, the risks are not distributed equally across the population, and risk attitudes are heterogeneous, as shown by Hung and Wang (2011) in a study about nuclear power plants. When risks and benefits are not equally distributed among citizens, there may be tension between what is 'best' for society on the one hand and an acceptable risk for many and an unacceptable risk for some in the proximity of the facility (e.g. Fischhoff et al., 1978; Slovic et al., 2007; Finucane

et al., 2000). Acceptability of the risk decreases when the benefits do not accrue to the people at risk, but rather to others in society (Vlek, 2013). The acceptability of the risk particularly decreases when the risk is perceived not as an unfortunate event, but rather as a result of human action and technological failure (Slovic, 1987). Usually, the deliberations about facts and opinions on associated risks and benefits are complex but take place before a siting decision about a facility is taken (e.g. Mena, Wiemer, & Bauchmann, 2013; Trutnevyte, 2014; van der Elst et al., 2016). The search for a balance between benefit and risk is an even more complex process in dynamic situations of emerging risks. This process is complex, because there is a lack of sufficient information before a decision is taken, and situations can change over time. Consequently, policy agendas that for long have been stable can suddenly be disrupted in a short period. The disrupted period during which the search for a new balance between benefit and risk takes place is further described by Baumgartner and Jones (2009) in their *punctuated equilibrium theory.*

2.3.3. Risk governance and the punctuated equilibrium theory

In developing their *punctuated equilibrium theory,* Baumgartner and Jones (2009) analysed a series of technological items, such as tobacco control and pesticide use. They inferred that the process of agenda building must deal with a complex system of actors and institutions. They argue in relation to a series of public risk issues: '*policymaking occurs in more or less independent subsystems, in which policies are determined by specialists located in federal agencies and interested parties and groups. These interests reach policy equilibrium, adjusting among themselves and incrementally changing policy*' (2009, p. 18).

According to Baumgartner and Jones (2009), organizations such as governments have the capability to handle many issues simultaneously through the use of many policy subsystems that each focus on one policy area. In these subsystems, experts in that particular policy area are able to decide on new and existing policies. These subsystems operate mostly away the spotlight, and many subsystems deal with policy issues that are so specific that a separate institution handles them. This institution, which is largely independent and specialist, takes decisions that are hardly influenced from the outside by media or public interference. If, however, an issue becomes more prominent, often because it attracts more public attention, it shifts up the political agenda and can become a macropolitical agenda issue.

When that happens, the issue is no longer dealt with by the subsystem alone, but multiple systems take on the matter at hand. At that juncture, the public and media can influence the issue, and political pressure rises. As long as policymaking can be done in one subsystem, consumers and media have hardly any interest or influence on it, and policy decisions usually remain constant. This is what Baumgartner and Jones call the negative feedback process. The positive feedback process takes place when an issue becomes macropolitical, where small changes in circumstances can lead to large changes in policy and cause future changes to be amplified. Baumgartner and Jones state that an issue can enter the positive feedback process either because it is so important or prominent that it cannot be ignored, or because a lot of small changes over time slowly but steadily build up to become an event that can disrupt the policy agenda. Issues that have been locked in a subsystem for a long time, receiving little to no public attention, can become more prominent when new risk and benefit information becomes available that is of interest to other stakeholders, making it prone to positive feedback. Consequently, the long-lasting policy equilibrium regulating the risks and benefits of technologies can change in a sudden disjointed manner when new interests are at stake, and new stakeholders or media can expand the conflict. The influence of media on risk is discussed in the next section.

2.4. Risk and media

In this section, I address the risk–media relation by first presenting the roles of the media and then the newsworthiness of risk for the media.

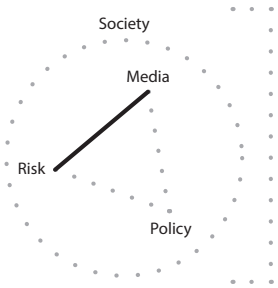


Figure 2.3: Theory of risk–media interaction

2.4.1. Roles of the media

In the literature, three media roles are distinguished: the democratic function, the agenda setting function, and the watchdog function. These three roles are briefly discussed here. Media function as democratic fora and offer platforms for discussion (Schudson, 2008). They provide information beyond their own direct experience (McCombs, 2004) and enable authorities to be checked on their performance (e.g.

Graber, 2004; Donohue, Tichenor, & Olien, 1995; Yang et al., 2016). In addition, media can transfer relevant risk information towards political actors or citizens and warn them about misbehaviour or unfavourable decisions; this is often referred to as media's *watchdog function* (Schultz, 1998; Korthagen, 2015). Thus, public judgement about risk governance network performance relies heavily on media attention.

2.4.2. Risk and newsworthiness

Binder et al. (2015) studied the role of media in their interaction with public risk and identified two critical factors: 1. the prominence of the risk itself and 2. the newsworthiness of the risk for the readers might be a trigger for reporting by the media. So, besides the media's democratic function, they try to reach readers because of commercial interests. Media not only transmit or produce news messages, but also are an institution with its own rules and logic (Hjarvard, 2008; Bennett, 2009). Media commercialization has led to increased competition in the media sector between media outlets. This has resulted in media logic becoming dominant, according to Landerer (2013). Media logic is defined as*: 'the assumptions and process for constructing messages within a particular medium*' (Altheide, 2004, p. 294). This definition of media logic emphasizes that media often operate by their own rules and aims to shape the content of the news coverage (Bennett, 2005, cited in Korthagen, 2015). Vasterman (2018) argued that news about public risk sometimes seems to develop in its own way, creating news waves or even media hypes, in which media logic plays a critical role. The regular news reports also refer to the journalism pack (Bennett, 2003), whereby journalists follow one another to report about the same subject during a media hype. Bennett (2009) argued that the tone of media reports is often biased towards personal, dramatic, and negative news issues because this satisfies readers' expectations and interests. Others have argued that journalists more often focus on scandals and incidents because this attracts readers, for example about clear events with personal, dramatic, and negative elements (Bovens, 2007; Hackett, 2001). The commercial aim of media organizations is to quickly create visual news that sells well to an audience that is attractive to advertisers (Walgrave and Van Aelst, 2006). Hence, the news reports are often: *'evocative, highly thematic, familiar to audiences and easy to use*' (Altheide, 2004, p. 294). Media focus on what is attractive for the audience instead of the public interest. Media logic leads to a growing power for the public in determining who provides the news and how an issue is addressed. The growing power of

media relates to the concept of mediatization. Mediatization indicates that media logic is penetrating more and more into other social spheres, such as society, politics, and policy (e.g. Mazzoleni & Splendore, 2015; Hjavard, 2008; Lundby, 2009). In contrast to the scholars who argue that media contribute to the accountability of others in controlling risk, others argue that they lead to goal displacement in controlling risk (Behn, 2001; Hillson & Murray-Webster, 2005). In his critique of SARF, Rip (1988) stated that media attention might amplify minor risk, leading to costly – but inappropriate – government attention. On the other hand, attenuation of risk issues by media may lead to the opposite, even resulting in a lack of preparedness.

Media may intentionally frame risk in a particular way and thereby influence how others perceive it and respond to it. For example, Jönsson (2011) studied the framing in news media about environmental risks in the Baltic Sea since the beginning of the 1990s and concluded that the reporting had been reasonably stable for three decades and focused on techno-scientific issues, including causes, and less on the negative consequences for society. However, very few longitudinal studies focus on changes in media reporting on a risk issue. Changing attention in media and politics towards a risky situation, and thus influencing risk perceptions in society, may contribute to a change in the debate in society, reflecting the interests of different stakeholders.

Media expose consumers to the frames, biases, and sentiments applied in newspaper articles. In selecting and applying frames, sentiments, and biases, the media take the receivers' social values into account. Framing an issue can be defined as '*a process of culling a few elements of perceived reality and assembling a narrative that highlights connections among them to promote a particular interpretation*' and '*make them more salient in a communication text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation and/or treatment recommendations*' (Entman, 1993, p. 52). Brüggemann (2014) notes that it is often unclear whether journalists in particular cases mainly transmit frames initially produced by others (frame sending), mediate information from others, or inform audiences with their own interpretations of an issue (frame setting), mediatizing available information. In reality, framing is often somewhere along the continuum between frame sending and frame setting. It is argued that the way in which media select and frame a risk issue may influence the perception and acceptance of a particular risk by society (e.g. Finucane et al., 2000; McCombs, 2004; Scheufele & Tewkbury, 2007).

News media play a prominent role in society, but social media also need to be considered as essential amplification stations (Hughes, Kitzinger, & Murdock, 2008). However, in social media, the distinction between news senders and receivers is less clear than with traditional news media. Fellenor et al. (2018), for example, studied the social amplification of risk on Twitter and concluded that social media play a vital role in amplification. They also introduced the concept of frame fragments to illustrate how information is selected and further transmitted on Twitter and other social media. Only certain features of the issue are emphasized and distributed on Twitter (Fellenor et al., 2018).

2.5. Media and their influence on policy and politics

Nicholas Garnham (1992) contended that public communication, and therefore mass media, is the heart of the democratic process. He argued that, in democratic processes, to develop a substantive meaning, citizens require access to sources of information and opportunities to participate. In his article about the social cognitive theory of mass communication, Bandura (2001) formulated two pathways through which media may influence human thoughts, feelings, and actions: first, the direct pathway by informing, enabling, motivating, and guiding citizens; second, the indirect socially mediated pathways through which media influence the creation and functioning of social networks and communities.

2.5.1. Media and risk governance

Several empirical pieces of research reveal that politicians anticipate journalists' reports (e.g. Strömbäck, 2008; van Aelst & Walgrave, 2011). Media, in their turn, report on the behaviour of politicians. Therefore, the interaction between media and politics is reciprocal (Kepplinger, 2007) and complex (e.g. Strömbäck & Nord, 2006; Vliegenthart et al., 2016). Some scholars found strong media influence when they focused on politicians' communication, but this may have limited implications for policy and decision making (e.g. van Aelst & Walgrave, 2011).

In his well-known article, 'The issue attention cycle', Downs (1972) visualizes the relationship between media, policy, and public attention as a multi-stage process. Downs' theory is often used to describe the process of public attention on policy issues, and it highlights the uneven development of both media attention and attention on policy issues (Eustis, 2000, p. 13). In addition to Downs' attention cycle, many authors

have studied the ripple effects of media on politics. In well-known theoretical postulates such as *conflict expansion* (Schattschneider, 1975), media play a critical role by reporting specific elements of the issue and initiate or stimulate public awareness. Baumgartner and Jones (2009), following Emmett Redford (1969), argue that this conflict expansion is critical to change risk policies in independent technical subsystems. The idea of conflict expansion is elaborated further in Cobb and Elder's (1983) classic study on agenda forming. They state that an issue gains a prominent position on the policy agenda only after additional advocates redefine the issue, by substituting one policy image for another (1983, pp. 44–47). Other scholars have also established the agenda setting function of the media for the political agenda (e.g. McCombs, 2004; Van Aelst et al., 2016; Walgrave, Soroka, & Nuytmans, 2008).

The role of mass media is crucial in this process of full recognition and awareness of a policy issue. Later agenda theories have built on these earlier works and expanded the theoretical perspectives on agenda forming and its relation to media attention. Kingdon (1995) emphasized the formation of policy ideas through a *window of opportunity*, focusing on the interaction of problems, policies, and politics as three independent streams. Kingdon argued that the window opens only at critical times, resulting in a decision agenda (Kingdon 1995, p. 166). Policy change and outcomes emanate from an open window. Media can play a major role in the opening of a window of opportunity by influencing the problems through intensive coverage of an issue, the policies by presenting a solution, and the politics by influencing public opinion – the voters – and therefore political opinion. Baumgartner and Jones (2009, p. 103) argue in their extensive research on agenda forming in the United States: '*A significant source of instability in American politics is the shifting attention of the media. Media outlets generally base their stories on a limited number of sources and imitate each other, so ideas and stories often rapidly spread once they have become a topic of interest.*' Vliegenthart et al. (2016) showed similar patterns of media–policy interaction in European countries.

2.5.2. Media logic and risk governance

Media have their own logic and rules because of commercial interests that influence the selection and tone of reporting (Bennett, 2009; Landerer, 2013). In general, media tend to select negative, dramatic, sensational, and personal issues in the news (e.g. Bennett, 2009; Gorney, 1992). Media logic should not be qualified as a positive or a negative

disrupting power, but as an inherent aspect of the media that can be strategically influenced by risk governance actors (van Twist, Klijn, & Van der Steen, 2013).

Kepplinger and Habermeier (1995) argued that key events that have specific news value because of high visibility can trigger news waves. Waldherr (2014) added other factors that trigger media attention cycles or mediatized conflict expansion. In addition to newsworthiness, she mentioned the importance of intermedia-agenda setting, issue sponsors, and attention thresholds. Attention thresholds refer to the psychological mechanism that helps to explain why some information is easier than other information for humans to understand. For example, the prominence of an earthquake cannot easily be understood when there is no norm value or standard comparison with another calamity. Intermedia-agenda setting may be partially a result of the competitive behaviour of journalists and media outlets, which forces them towards herding behaviour in the journalism pack (Bennett, 2003). Besides, journalists may also be sensitive to attention thresholds, as they help them to add news value. Furthermore, stakeholders may raise their voice when a key event receives media attention. Such issue sponsors are unusual additional sources for journalistic reporting.

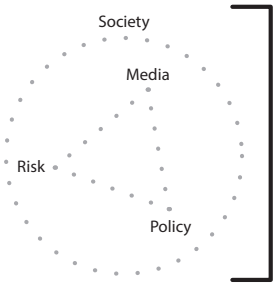


Figure 2.4: Theory of public risk and society

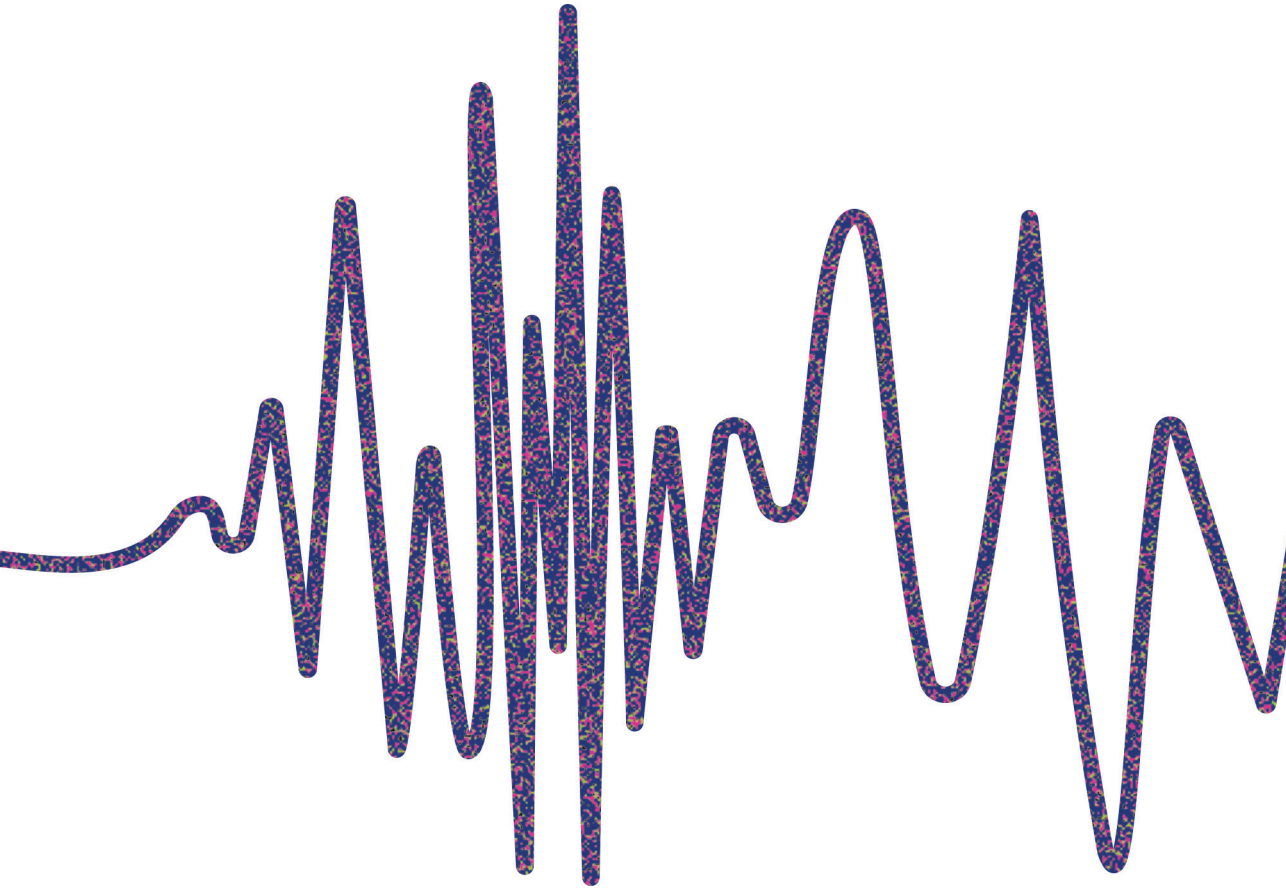
2.6. Risk policy and governance in the media age

In this thesis about the media–governance–risk interaction, the main focus is on media's role in the governance of risk. The creation of risk as a social construct plays a central role.

On the basis of literature on risk, media, and governance, it can be theorized that media may play a vital role in raising awareness about a risk, putting pressure on risk managers to focus on the reduction of future risk, by either preventing the hazard or reducing it or its consequences to a level deemed tolerable for society. Risk preparedness is a critical element of risk governance. Media are in a position to influence the focus of the public debate (Nisbet, 2014). Therefore, they can choose to emphasize the risk elements or the benefits of technology.

Media-centred frameworks about risk can thus be helpful to explain the attitude transition – or lack of it – in risk governance of the gas drilling risk. Anita Howarth (2013, p. 1) argues*: '…those media-government-interactions are critical to the trajectory of risk debates. These interactions are dynamic entailing multifaceted shifts in responses and counter-responses – positions, arguments/discourses/representations, and actions – during the course of a scare.'* She explored the dynamics in the political–media complex with various media-centred and policy-based frameworks.

As mentioned in Chapter One, SARF offers a framework to describe the dynamic interaction between risk, media, and policy, as it incorporates the public risk–risk attitude interaction. Risk signals may generate responses in society, such as adverse effects on the local economy, erosion of public trust, and, above all, social and political pressure for alternative risk management. These social responses may ripple further in society and the political arena, leading to new risk management decisions and changes in risk governance. Particularly in situations where the balance between risk and benefit is complex and dynamic over time, the production of news requires further study because experimental studies are scarce, according to Binder et al. (2015). Media reporting is essential in the social construction of risk. The way in which media select and frame risk issues also influences the creation of ripples and thus can have direct or indirect impacts in the social sphere, the political sphere, and the policy governance sphere. Howarth (2013) criticized the simplified linear risk–media–policy model of the role of media in SARF and calls for more research in the field of media–risk–policy interactions. However, when SARF is integrated with the risk–media centred framework, it may further Baumgartner and Jones' punctuated equilibrium theory, i.e. that long periods of policy stability and media attention on a known risk may change suddenly in a disjointed manner. According to Vasterman (2018), media are not just reporters of events; they also create them, or at least influence the chain of events after the key events. So, what the key events are for the media is essential for risk–media–policy interactions. Nevertheless, on the other hand, the media may also neglect risky situations in the absence of key (trigger) events. Consequently, the social construction of the risk may be attenuated according to Rip (1988), potentially resulting in a lack of preparedness. In the upcoming chapters, these theoretical implications are discussed in the light of natural and human-induced earthquakes in Italy and The Netherlands, respectively.



Chapter Three: Framing a Conflict! How Media Report on Earthquake Risks Caused by Gas Drilling

Abstract

Using a new analytical tool, supervised machine learning (SML), a large number of newspaper articles are analysed to answer the question of how newspapers frame the news of public risks, in this case of earthquakes caused by gas drilling in The Netherlands. SML enabled the study of 2265 news articles published over a period of 25 years. Our study shows that there is a disproportional relation between media reporting and actual risk; and that the use of dramatization bias in framing the issue about gas drilling increased, but the use of personalization and negativity bias did not become more dominant after a major media change in 2013. Sensational/tabloid newspapers make more use of personalization bias, whereas quality newspapers make more use of value conflict and political disagreement in the framing about gas drilling.

This is an adapted version of the published article:
Opperhuizen, A. E., Schouten, K., & Klijn, E. H. (2019). Framing a conflict! How media report on earthquake risks caused by gas drilling: A longitudinal analysis using machine learning techniques of media reporting on gas drilling from 1990 to 2015. *Journalism Studies*, 20(5), 714-734.

3.1. Introduction: media attention on public risks

Risk events and issues are popular objects of news reports. News media seem to be more interested in the dramatic aspects of the news than in presenting information about the risk event itself or the background to it (Beattie & Milojevich, 2017) This reflects what several scholars argue about media: they make use of particular reporting frames to serve and inform their audience and to make the information comprehensible for the readers (Semetko & Valken, 2000; Entman, 2007; Baumgartner and Jones, 2009; Bennett, 2009; Patterson, 2000). According to the mediatization literature, attracting a large audience has become more and more important because of commercial pressure on media (Cook, 2005; Bennett, 2009; Hjarvard, 2013; Strömbäck & Esser, 2014). The claim in this literature (but also in other literature, like agenda forming and risk literature) is that the institutional rules of media are more and more dominated by commercial rules (reaching a wide audience) and that this has consequences for the frames and biases that media use in news provision (more sensational, dramatized, etc., see Bennett, 2009). This literature also emphasizes that the logic of the media is penetrating other spheres of society (especially politics), which they call the "mediatization of society" (Hjarvard, 2013; Strömbäck & Esser, 2014). If it is true that (some) media use a particular bias in their frames to serve their readers for commercial reasons, then that is an important observation, because media are a major source of information for citizens to reach a judgement about public risk events (Renn, 1992). Although the literature often argues that this mediatization trend is visible in almost every part of the media landscape, the so-called tabloids/sensational newspapers are supposed to be more susceptible to using mediatization bias in their reports than quality newspapers are (Uribe and Gunter, 2007). Public risk issues are attractive for news media (Slovic, 2000), and consequently media coverage of these risks may be particularly prone to framing the news in a mediatized way (Hjarvard, 2013; Strömbäck & Esser, 2014). Critics state, however, that the empirical support for the claims in the mediatization literature about the penetration of institutional media rules and the resulting influence of media in other spheres of society is to date not very impressive (for this criticism, see Vliegenthart, Boomgaarden, and Boumans, 2011; Van Aelst et al. 2014). There is certainly little research in this field about the reporting of public risks. Therefore, in-depth analysis of risk events and their media coverage is needed, preferably covering a

long time period to look at the use of media frames and biases about emerging public risks.

The gas drilling case in The Netherlands offers a very good opportunity to study media attention over a long period and at the same time provides in-depth knowledge about media attention on a case with public risks. The risk of earthquakes in The Netherlands is a consequence of human activities. Since 1960, the Dutch State has allowed gas drilling in the northern region, which generates high revenues but also increases public risk. Media reporting on this risk was very limited for many years. In recent years, the increasing frequency of earthquakes has led to a broad social and political debate about the benefits and risks of human actions to drill for gas. In this social and political debate, news media play a critical role. The way in which media frame the risk of earthquakes is therefore important. This leads to our research questions:

> **RQ1**: How do media pay attention over time to the risks of earthquakes as a result of gas drilling in The Netherlands?
>
> **RQ2:** Which news biases dominate this attention, can differences during the time period be observed, and does this differ for various newspapers?

In this study, we look at news items in five different newspapers over the last 25 years about gas drilling in The Netherlands. To be able to analyse a large number of news items, a relatively new research method was applied in this research, i.e. machine learning techniques (language processing). On the basis of handmade codes, the computer "learned" to recognize codes in documents, and this enabled us to analyse a large dataset of news items (N = 2265 items).

3.2. Media logic as institutional feature and its consequences for media reporting on public risks

News media fulfil a democratic and a commercial task when distributing information to the public. In their democratic function, media inform the public and can operate as a watchdog in the political system (Bennett, 2009). In the case of public risks, this means that they can raise awareness about the nature of the risk and its consequences; but

they can also alert citizens to stimulate public discussion or to take action to mitigate the risk. A model for how information about risk and its consequences is communicated in society has been proposed by Kasperson et al. (1988). In their social amplification of risk framework (SARF), they postulate how communications about risk events and issues pass from sender to message receivers through intermediate stations. These stations can be persons, groups, and organizations, but especially the media. During transmission of the messages, each station can add biases to reframe the message, which may result in attenuations or amplifications of the perceived risk. Whether or not information about a risk has a serious impact on society is, according to SARF, to a large extent determined by amplifier stations, which further disseminate and transfer messages about the risk so that it ripples through society. A risk issue can easily be amplified in society when emotional elements are added such as anger, fear, conflict, trust, and (lack of) compassion (Renn, 1992 ; Slovic, 2000). Thus, media reporting about risk is not necessarily a reflection of the actual hazard and its primary consequences. Johnson and Covello (2012) argued that media may exaggerate some risks and ignore others, because media tend to focus on drama, wrongdoing, and conflicts. Soumerai, Ross-Degnan, and Kahn (1992) concluded that media tend to concentrate on rare and dramatic hazards and often fail to report common serious risks. Recently, Stewart and Lewis (2017, p. 122) argued that, in the field of geoscience communication, "factual information is to be subordinate to values and beliefs". Wahlberg and Sjoberg (2000), however, concluded that news media are not always as biased in their reporting as often thought.

Media are not only transmitter stations reporting about risk and other issues of interest to society. They are also commercial entities that have to survive in a competitive market (Landerer, 2013). Several scholars have argued that this commercial interest is reflected as an institutional practice of the media – called media logic – i.e. a set of rules and practices regulating actors' behaviour within media as an institution (Cook, 2005; Scott, 1995; Asp, 2014; Klijn & Koppenjan, 2016; Esser & Strömbäck, 2014). Media logic, especially the rules that are connected with the need to survive in a competitive commercial market (see Landerer, 2013) may significantly influence the selection (content) and tone of news coverage, introducing biases that find their origin in pressure for media to reach a large audience and portray the news in such a way that it is attractive to a large audience. General

application of media logic results in similarities of content and sentiment of news coverage in various media, a number of authors argue (Altheide & Snow, 1992; Hjarvard, 2013; Landerer, 2013). In general, media logic may result in less factual information, and the news may contain more human-interest stories and drama to attract news consumers (Mazzoleni & Schulz, 1999; Bennett, 2009; Hjarvard, 2013; Strömbäck & Esser, 2014).

Media logic manifests itself in the framing of news content. A frame is described by Entman (1993, p. 52) "as a process of culling a few elements of perceived reality and assembling a narrative that highlights connections among them to promote a particular interpretation" and "make them more salient in a communication text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation and/or treatment recommendations". A frame tells what elements are meaningful and are uncovered by stories and storylines. In media articles, they are mainly represented by certain (combinations of) words, emotional meanings, and combinations of these (see also Entman, 2007).

Patterson (2000) looked at 10 years of news production in the United States and noticed a trend towards more negative attention (especially towards politicians) and a move towards soft news and attention on personalized news. Bartholome, Lecheler, and de Vreese (2015) reported that journalists commonly use storytelling, adding elements of conflict to a story to transform events into news commodities. This may result in personalized stories resulting in a situation of news as a sales commodity, rather than news as transferring information in a meaningful way to the public, such as to inform and educate citizens, to publicize actions of the government, to provide a platform for competing or dissenting opinions, or to serve as an advocate of competing political views (Mcnair, 2009; Eberl, Wagner & Boomgaarden, 2016). Flew and Swift (2015) argued that, because media have to compete for attention in the public sphere, journalists have to present more details about the issue in a more dramatic way (see also Esser 1999; Slovic, 2000). This observation fits with Baumgartner and Jones' (2009) conclusions in their agenda-forming study about journalists' preference for conflict. In an in-depth analysis of six Dutch spatial projects and their decision processes, Korthagen (2015) showed that conflict and dramatization biases are clearly present in media attention on these projects. The way different media outlets use biases may also depend on whether they are more or less sensation orientated. More sensation-focused newspapers

(the so-called tabloids) attempt to make themselves more attractive by entertainment-oriented stories, and news items become more sensational (Blumler & Gurevitch, 1995; Grabe, Zhou & Barnett, 2011). Earlier research has shown that sensationalistic newspapers are more focused on personalization and conflict than quality newspapers are (Norris & Kennedy, 2001). Sensationalistic newspapers also use more biases in their framing that provoke emotional reactions with readers (Mott, 1962). Entman (2007, p. 166) defined "…consistent patterns in the framing of mediated communication …" as a bias. He argued that, by introducing biases, one particular side of an issue of interest is highlighted by a media outlet. As news reports must be saleable, the information from media has certain biases. A media bias can be seen as "structural unreality of images" (Baudrillard, 1995, p. 46). From the work of a variety of authors (such as Patterson, 2000; Bennett, 2009; Burscher et al. 2014; Korthagen, 2015), common information biases may be identified when media make consistent use of narrative elements referring to the following:

1. Personalization bias: a strong tendency in the news to emphasize the personal aspect of news and downplay the socio-economic or political context in which the event takes place. Emphasizing the personal aspect of news may make the news more appealing to readers and viewers, but the greater complexity of the issue may be ignored or relegated.
2. Dramatization bias: a strong tendency towards dramatizing news, emphasizing crisis and conflict in stories, rather than continuity or harmony.
3. Fragmentation bias: an increasing focus on isolated stories and events, separating these from the wider context and from one another.
4. Authority–disorder bias: a preoccupation with order and whether authorities are capable of maintaining or restoring that order. At the same time, a shift has taken place from an attitude where the media are favourable to politicians and authorities towards an attitude where they are suspicious of them.
5. Negativity bias: the tendency of the news to be more negative in general.

Baumgartner and Jones (2009) studied the media reporting of various public risks and benefits in the United States of America. They showed that policy systems and the agendas in these systems may be stable for a long period but then show rapid changes as a result of continuing

pressure from outside. Media attention is very important in building up this pressure, they find. Or as they formulate it:

> "A major source of instability in American politics is the shifting attention of the media. Media outlets generally base their stories on a limited number of sources and imitate each other, so ideas and stories often spread quickly once they have become a topic of interest." (Baumgartner and Jones, 2009, p. 103)

Baumgartner and Jones also observed that media have a fascination with conflict and competition and that media attention seems to generate more media attention (positive feedback). This is in line with observations of other authors that journalists have a tendency to follow one another because they are afraid to miss a scoop, and thus media attention tends to generate more media attention (Bennett, 2009). These theoretical observations lead us to the following hypotheses about our case (gas drilling and its media coverage):

> **H1:** Media attention increases disproportionally when actual risk events (number and intensity of earthquakes) increase;
>
> **H2:** From the onset, media disproportionally increase their reporting about the risk of earthquakes, with a tendency for all newspapers to reframe the news content using more personalization, dramatization, and negativity biases;
>
> **H3:** The use of personalization, dramatization, and conflict biases to frame the news will be more prominent in sensational newspapers than in quality newspapers.

3.3. The case: gas-drilling earthquakes 25 years in the media

Gas drilling started in the early 1960s in the northern part of The Netherlands after a large volume of gas was discovered. Production and sales of this gas have resulted in very large revenues for the Dutch government. The gas drilling activity, at €280 billion, is an important activity for the Dutch economy. Gas drilling also has negative consequences however; it causes land subsidence and earthquakes.

3.3.1. Gas drilling in The Netherlands: actors and responsibilities

After the gas fields were found, a public–private collaboration was established, called the 'gas building' (In Dutch: het gashuis). The natural gas exploration company (NAM) is responsible for safe extraction of gas and for the external effects of the extraction. It makes a production plan, which has to be approved by the Minister of Economic Affairs. The minister has authority on behalf of the State over gas extraction, including licences for exploration and exploitation. The minster has the power to approve, disapprove, or attach conditions to the production plan. The controlling agency (an inspectorate) is the State Supervision of the Mines (SodM) (in Dutch: *Staatstoezicht op de mijnen*). SodM ensures that all parties comply with the legislative rules, and it monitors the implementation of gas extraction. The supervision authority focuses on safety, health, milieu, and effective extraction.

3.3.2. Earthquakes in The Netherlands: facts and figures

The first earthquakes started in the late 1980s, and the frequency and magnitude have increased since then. In 1994, more than 20 were detected; this number decreased until 2003. From 2003 to 2015, there was a substantially higher risk compared with the 1990s. Peak years for the number and magnitude of earthquakes were 2003, 2006, 2009, and from 2011 (see Figure 3.3 in results section).

3.3.3. Risk development and media

In the first decades of gas drilling, experts evaluated land subsidence as the only negative side-effect of gas drilling. Although land subsidence was seen as an undesirable side-effect, experts did not predict great risk concerns. However, the issue of public risk arose when in 1986 the number of earthquakes increased. The relation between gas extraction and risk effects has been proved since 1993 (KNMI, 1993). The risk of earthquakes was higher and more complex than was initially thought, but the concerned parties did not see the earthquakes as a safety problem but rather as a material damage problem, e.g. cracks in houses (Dutch Safety Board, 2015). Although in 2003, 2006, 2009, and from 2011 there was a significantly higher risk (stronger earthquakes of >3, 3.5 Richter scale), this did not lead to a perception change by concerned parties, social groups, or mass media (Dutch Safety Board, 2015). News media did not pay much attention to the risk of land subsidence resulting in damaging nature and houses. In

August of 2012, a larger earthquake (3.6 Richter scale) occurred, and this earthquake led to activity in the policy sphere. The controlling agency, SodM, started a risk analysis. At the beginning of 2013, SodM published its report, which concluded that safety cannot be guaranteed for the inhabitants of the northern region. This warning functioned as a trigger event and awoke new interest in the earthquake risk. The concerned parties, especially the minister, were requested to take action. Citizens felt more unsafe and angrier towards involved parties. Citizens' trust level dropped to an absolute minimum, because the citizens assumed that the concerned parties had downplayed the seriousness of the risk situation and because of the lack of transparent information (Dutch Safety Board, 2015). The increased risk itself and the SodM warning gave rise to increased social, media, and political attention. In 2014, the Minister of Economic Affairs presented a package of measures to ensure the safety of civilians. At the minister's request, the Dutch Safety Board decided to launch an investigation into the decision making process. The Board (2015, p. 7) concluded that: "the parties concerned deemed the safety risk to the population to be negligible and thus disregarded the uncertainties surrounding this risk assessment".

3.4. Method: machine learning technique

This media analysis, which uses a supervised machine learning (SML) technique, is based on a study of five Dutch newspapers over the period 1990–2015 on gas drillings in The Netherlands. A case study approach was chosen because of the ability to generate in-depth knowledge of media reporting and news framing of public risks. The gas drilling case is interesting because of the long period of time in which the drillings took place, the changing perspective on the public risk of gas drilling, and the change in media coverage over time. This allows a longitudinal study of frame variation in media coverage.

3.4.1. Data collection

In this article, one local and four national newspapers are selected. The national newspapers have different political orientations: *Dagblad van het Noorden* (a locally oriented newspaper), *NRC Handelsblad* (a centre-right quality newspaper), *de Volkskrant* (a centre-left quality newspaper), *de Telegraaf* (a right-leaning sensational newspaper), and

Algemeen Dagblad (non-politically orientated sensational newspaper). The articles were selected from digital archive LexisNexis NL. The search query "Gaswinning OR gasboring AND Groningen AND NOT Waddenzee" was used to select the relevant articles. Although LexisNexis is a comprehensive newspaper database in The Netherlands, the local newspaper *Dagblad van het Noorden* was only available from 1999 to 2016. The national newspapers were available from 1990 to 2016. This may have led to some missing information in the sample reports. A total of 4113 articles were found in the database. Because *Dagblad van het Noorden* has geographical variants (i.e. North, East, South, and West editions), one news article from this newspaper could appear in each edition, which led to many duplicates in our dataset. After removing all duplicate news items, a total database of 2265 relevant media reports constitutes the final sample. Eight hundred and twenty-six (36 per cent) of the reports originate from the national newspapers and 1439 (64 per cent) from the local newspaper.

3.4.2. Qualitative content analysis

The unit of analysis was a news report. First, a subset of 102 media reports was used for inductive human coding. After a first indicative round of coding, Patterson's (2000) coding scheme in combination with Burscher's et al. (2014) frame indicator questions for quantitative content analysis was used. Patterson's code scheme does not provide yes or no indicator questions for analysis. Hence, the indicator questions in Burscher's et al. (2014) media frame analysis are used. Of the five information biases mentioned above, only three could be operationalized. For fragmentation and authority bias, no adequate operationalizations could be developed. This study focuses on:

1. Personalization, operationalized as: Is the story about the use of the human-interest frame? Human interest stories use a human. Labelled categories are yes or no.
2. Dramatization is operationalized in two ways: (1) political disagreement is operationalized as: Does the item reflect disagreement between parties, individuals, groups, or countries? (2) value conflict is operationalized as: Does the item refer to two sides or more than two sides of the problem? Labelled categories are yes or no.
3. Negativity is operationalized by Patterson as: Is the report favourable or unfavourable towards gas drilling? Labelled

categories are positive–neutral–negative. To illustrate this in more detail, three examples are given:

- An example of a news item coded as positive:
  "The country is fully self-confident and proud, they not scared of anyone. From the periphery, we have become the centre. The classic image of the needy, indigent, and distressing North no longer exists. This is a performance of format."

- An example of a news item coded as neutral:
  "The gas extraction in Groningen will be limited to 27 billion cubic meters until 30 September 2016. Minister Henk Camp of Economic Affairs follows the judgment of the State Council, which said last month that no more than 27 billion cubic meters should be extracted."

- An example of a news item coded as negative:
  "The gas operator NAM apologizes for the earthquake distress in Groningen. But they do not even think about a production reduction, it is all about the money and not about the people."

Then, the human-coded subset of 102 articles was exported from ATLAS.ti to XML and formed the input for the machine learning component.

3.4.3. SML: train model, predicted codes, and evaluate performance

SML was preferred over solely human-coding content analysis because it enabled us to code biases in the news without relying on a small sample. With this technique, a computer learns to code from a set of human-coded training documents (Sebastiani, 2002). In this longitudinal study, a set of 2265 articles was available and, because it is not feasible to annotate such a great number of news items manually, a machine learning approach was taken, in which an algorithm learns to recognize patterns in the text that correspond to the manually assigned codes. In this way, only a subset of the news items needs to be human-coded, as the machine learning algorithm is able to predict the codes for the remainder of the dataset. Burscher et al. (2014) also concluded that SML is well suited for frame coding, for theory but also as a methodology. Lazer et al. (2009) argued that computational social

science can help with comprehensive societal-level communication patterns. More specifically, and in line with this study, other scholars have argued that SML can contribute to substantial issues in framing reaches, including "looking at frame variation over time" (Matthes & Schemer, 2012). As the machine learning algorithm is a statistical method that works with numerical values, it cannot work with plain textual documents. Figure 3.1 shows the three processing steps that are performed to transform the plain text documents into numerical vectors that can be used for machine learning.

Java was applied in the programming process. The first step is a pre-processing step that involves cleaning the document of any formatting and adjusting the text to prevent mistakes later on in the process. For instance, headlines of news items do not have a full stop at the end, but, when formatting is removed, a headline is hard to separate from the first sentence of the actual news item. Adding an extra empty line makes it clear that this is a separate sentence. The same is true for sentences that end with a quote, as the full stop is usually put inside the quote. However, with a full stop denoting the end of the sentence, the end quote is by default incorrectly merged with the next sentence.

The second step consists of running the pre-processed documents through a natural language pipeline for Dutch, called Frog, which extracts all kinds of linguistic information from the text (Van den Bosch et al. 2007). On a basic level, it splits the text, which is simply a long list of characters for a computer, into groups of characters that comprise words. Then, the list of words is grouped into sentences, followed by determining the word type of each word within the sentence (e.g. nouns, verbs, adjectives, and so forth). Furthermore, the words are morphologically analysed, which means that they are related to their lemma, or dictionary form. This step is useful, because it allows the algorithm to know that some words, even though they are different in form (e.g. be, are, and is), are practically the same in meaning. Another task for the morphological analyser is to split compound nouns into their constituent parts. As the Dutch language allows for the creation of new nouns by simply compounding two or more existing nouns, it is informative to know the constituents. For example, the Dutch word *aardgasbeving* (i.e. natural gas earthquake) is split into *aard* (earth), *gas* (gas), and *beving* (quake), relating it to the more regular word *aardbeving* (earthquake) because it shares two constituents. For humans this is apparent, but for computers, when two lists of characters are not exactly the same, they are completely different—a fact that is often

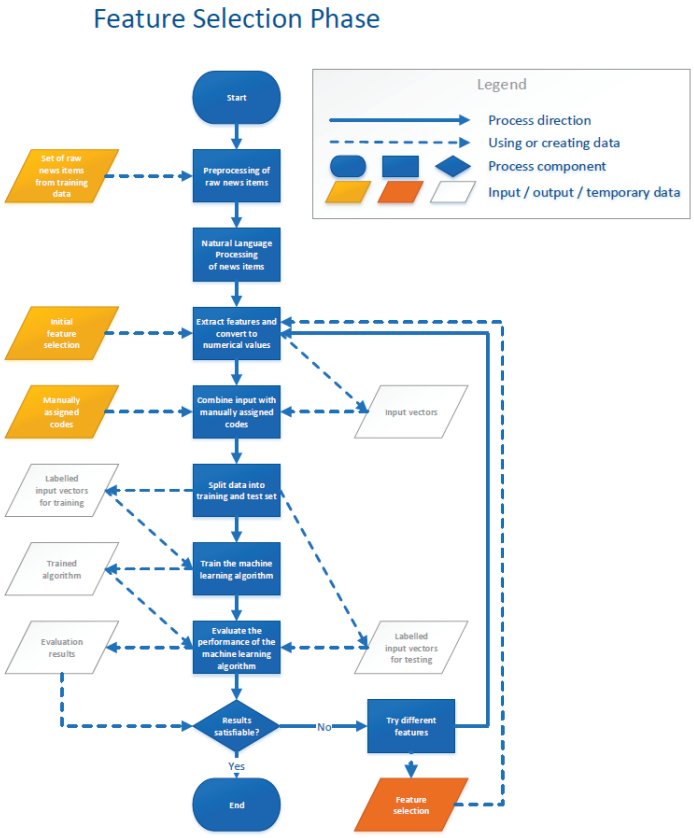


Figure 3.1: The machine learning process – continued on the next page

useful, as words and their inverted counterparts can be quite similar (e.g. (un)informative, hypernym vs. hyponym). The last step in this part of the process is to combine words that are part of a phrase or chunk, by assigning them a chunk tag. Chunks are multi-word expressions that together have a different meaning than when considered separately (e.g. United States of America).

The third step is to select from all this information those bits of information—called features—that are expected to be informative with respect to the prediction task. This feature designing and feature selection phase are repeated multiple times until satisfactory results are achieved. By training the algorithm using a selection of features and measuring its performance, useful feedback is retrieved that can

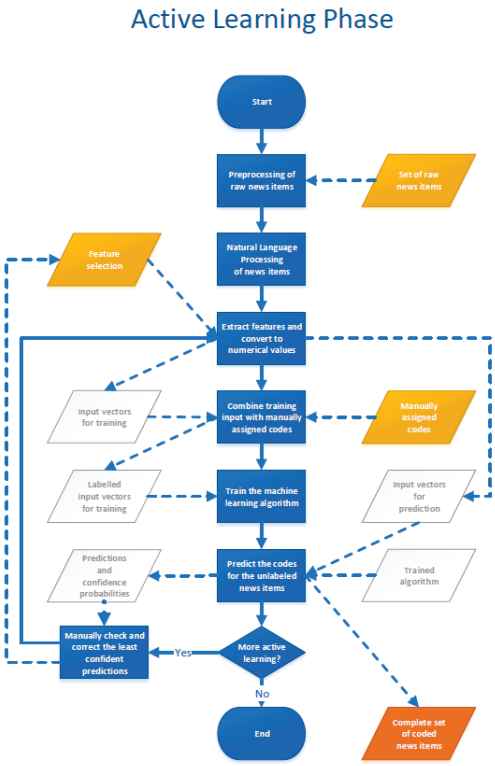


Figure 3.1: The machine learning process, continued

help in designing and selecting better features. In this work, the set of selected features consists of the lemmas of the words in the document, the chunk tags assigned to the words in the document, and the morphological constituents of words in the document. All these features are binary, meaning that they are encoded with a 1 if present in the document and a 0 otherwise. The Support Vector Machine (SVM) implementation is based on SMVLib. Hence, the input vector has a length equal to the number of different features, with mostly 0s and a relatively small number of 1s, see Figure 3.2.

Besides these binary features, a sentiment dictionary from the CLiPS Pattern project (De Smedt & Daelemans, 2012) is used to count the number of positive and negative words in a document, as well as the

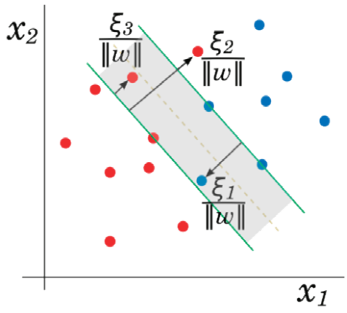


Figure 3.2: Visualization of the Support Vector Machine

number of objective and subjective words. Furthermore, as each word has a numeric value in this dictionary for sentiment and subjectivity, a total sentiment value and a total subjectivity value is also computed. These values are added as numeric features to the input vector. The machine learning process consists of two phases: a feature development phase (left side of Figure 3.1) and an active learning phase (right side of Figure 3.1). In each phase, the textual input is processed modelled as a vector of numeric values, as described above. In the first phase, different sets of features are experimented with and the main output is the definitive set of features used to predict the codes. The feature selection is used as input for the second phase, where active learning is used to check and correct the predictions about which the algorithm is least confident. After a certain number of rounds of active learning, the generated predictions are final and the content analysis can commence.

3.4.4. Accuracy and reliably

To ensure that the given results are accurate and reliable, two scores are computed: the accuracy score (how accurate the algorithm is) and the standard deviation (how precise the algorithm is in the case of repeatability). The accuracy of the algorithm is measured with an F1-score, a measure that is the harmonic mean of precision and recall. Precision, as formulated below, measures how many of the predictions that have been made by the algorithm are correct.

Recall, as formulated below, on the other hand, measures how many of the codes that should have been predicted are actually found by the algorithm.

$$\frac{\text{Correctly predicted codes}}{\text{Correctly predicted codes + Incorrectly predicted codes}}$$

$$\frac{\text{Correctly predicted codes}}{\text{Correctly predicted codes + Missed codes}}$$

Figure 3.3: Correctly predicted codes

Precision and recall balance each other, in the sense that it is easy to get high precision at the expense of having low recall (e.g. predicting only a few instances that are easy to find) and high recall at the expense of low precision (e.g. predicting a code everywhere). The F1-score represents the balance between these two important measures. Traditionally, to measure performance, part of the manually coded dataset is used for training the machine learning algorithm, and part of it is reserved for testing only. This ensures that one is measuring the predictive power of the algorithm rather than goodness of fit. As the manually coded portion of the dataset is relatively small, the performance of machine learning will vary based on which news items are in the test set. If the test set consists of news items that are easy to classify, the performance will obviously be higher than when the test set consists of hard-to-classify news items. To counter this, the algorithm is run 20 times, where the split between the training and the test set is randomly performed each time. The reported F1-scores are therefore the average score over those 20 runs. To give an impression of the stability of the results, the standard deviation over those 20 scores has also been computed. The higher this number, the larger the variation among those 20 F1-scores. To achieve a higher F1-score and lower variation, a procedure called Active Learning is employed. With Active Learning, the machine learning algorithm is used to produce not just the predictions themselves, but also the probability for each possible code. A low probability indicates that it was hard for the algorithm to assign a code to that news item. Then, for each code, the news items with the lowest probability are manually coded and added to the training set (based on the coding scheme Table 3.1). In Table 3.2, an overview of the performance for each of the codes is presented, before and after performing a round of Active Learning. The last column denotes the majority baseline, which entails simply predicting the dominant code for each news item. For example, as about 73 per cent of the news items have the "No disagreement" label, the baseline, by naively predicting "No disagreement" for all news items, would achieve an *F1-score* of

Table 3.1: Coding scheme—questions for bias indications (this conceptualization is based on Patterson, 2000, p. 24–26 and Burscher et al., 2014, p. 197)

Definition	Indicator questions	Category
Personalization bias Personalization bias add a human face to new coverage.	Does the item provide a human example or human face on the issue?	Yes No
Dramatization bias Highlights conflict between individuals, groups or institutions.		
Political disagreement = the political disagreement bias highlight conflict between political actors.	Does the item reflect disagreement between political parties about the technical activity of gas drilling?	Yes No
Value conflict = The value conflict bias highlight conflict in groups in society between benefit on the one side (the winners) and the risk (losers) on the other side.	Does the item refer to who sides (financial gains vs. earthquake risk) of the gas drilling activity now nor in the future?	Yes No
Negativity bias This code is designed to pick up whether the story is though on the whole to be in the good news or bad news category. In some instances, it might be helpful to ask the following questions: if about a newsmaker and you were his/her press secretary, would you consider this a favorable or an unfavorable story? If about an institution (e.g. Congress), does this reflect favorably or unfavorable on the institutions? (Patterson, 2000)	Is the report favorable or unfavorable towards gas drilling?	Positive Neutral Negative

Table 3.2: F1-scores

	***F1*- score before active learning**	***F1*- score after active learning**	**SD**	**Majority baseline**
Negative	0.46	0.53	0.11	0.42
Political conflict	0.71	0.74	0.11	0.63
Value conflict	0.78	0.81	0.09	0.72
Personalization	0.82	0.82	0.08	0.72

73 per cent. Intuitively, to have any added benefit, an algorithm should exceed this baseline, as is the case for each of the codes. Note that this baseline is thus an indicator of how difficult it is to predict this code. It

is naturally a lot harder to predict the sentiment code correctly than for instance the disagreement code. All the codes are above the baseline.

3.5. Results

3.5.1. How do media pay attention over time to the risk of earthquakes?

The results show that the risk of earthquakes as a result of gas drilling did not attract much attention in the national Dutch newspapers until 2012. Annually, for each newspaper, fewer than 10 news items covered this risk. *NRC Handelsblad* started reporting about the risk of earthquakes in the 1990s, with a few (n=27) articles in the period between 1990 and 2002, but other national newspapers did not follow.

In 2002, other newspapers started to become interested, which the exception of *Algemeen Dagblad*, which started to report about this topic only in 2008. The national newspapers increased their reporting from 2002 to 2006, followed by a small decrease in 2007 and 2008; see Table 3.3. A slight increase followed in the years 2009 to 2011, again followed by a small decrease in report numbers in 2012. The local newspaper (*Dagblad van het Noorden*) is an exception and started to increase covering the news about risks a few years earlier than the national newspapers; see Table 3.3. From 1999 onwards, usually 10 or more news items were reported annually until 2012. Both for the local and the four national newspapers in 2013, the number of reported news items increased at least tenfold and increased further in 2014 and 2015 (see Table 3.3). The results show a disproportional increase in media attention after 2013, revealing that media attention was only partially related to the increased risk itself in this period.

3.5.2. What news biases are used in framing the risks and benefits of gas drilling?

To unravel the potential use of information biases in framing by the newspapers over the 25 years of news coverage, a separation was made between the period before and after 2013. As there were a disproportional number of articles before and after 2013, the media coverage from 1990 to 2012 is combined. The potential use of information biases was studied using the SML outcomes. The application of biases is shown in Figure 4: panel a: personalization; panel b: political disagreement; panel c: value conflict; and panel d: negativity.

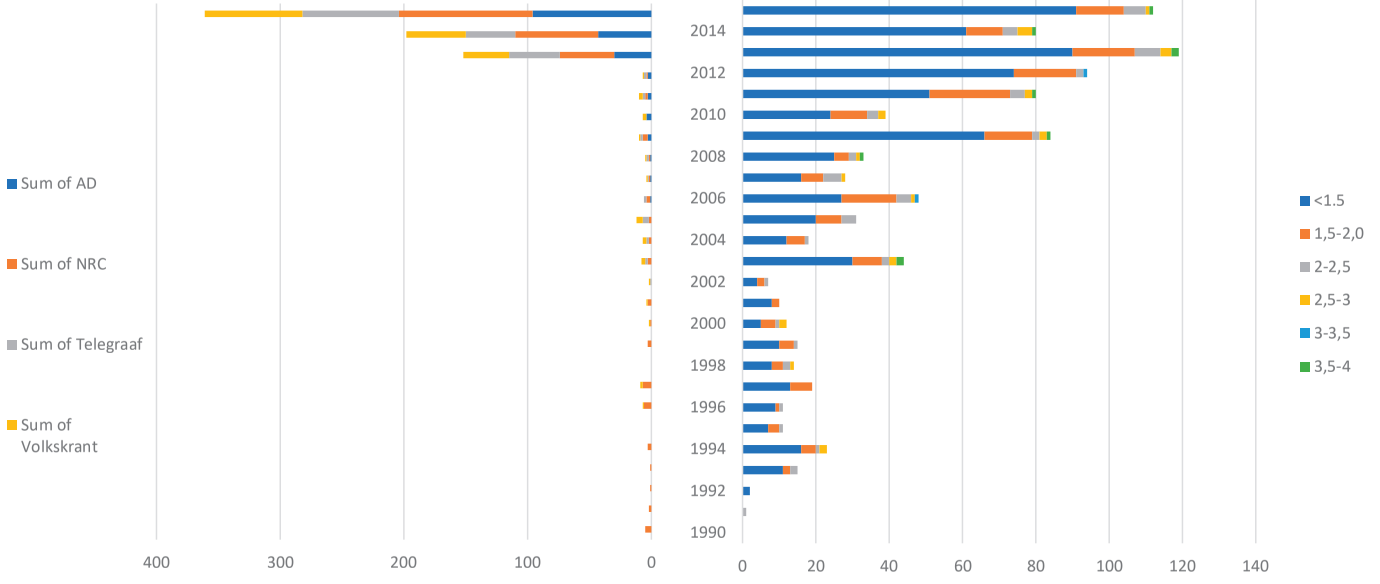


Table 3.3: Number of news articles (left) and earthquakes (right) per year

Personalization

In 20 per cent in 1990–2012 and 40 per cent in 2014 of the news articles, there were strong elements of a human story, human face, or human example (see Figure 3.4(a)). There was no proportional rising or falling trend in the use of personalization bias. The slight drop in the use of personalization bias in 2013 was followed by an increase in 2014. After the following drop in 2015, again in about 33 per cent of news items a personalization bias was applied, comparable to the period 1990–2012, despite the large increase in the total number of news item. This is interesting, as the mediatization literature suggests that there is a growing trend towards personalization. We cannot find this trend in our data.

Dramatization: political disagreement and value conflicts

An increase in the use of a political disagreement bias by all the newspapers each year is seen after 2012 (see Figure 3.4 (b)), i.e. the use of a political disagreement frame becomes more prominent in reports from media outlets. Before 2013, almost no news media addressed political disagreement. There was a linear increase of 5 per cent in all the news reports each year, meaning that in 2015 about 15 per cent of all the articles covered this dramatization bias. This could of course be related to the fact that after 2013 the issue was also discussed more in the political arena and the discussion about reducing the amount of gas drilling started. Even more prominent in the years 2013–2015 is the reporting about value conflicts, but even before 2012 approximately 10 per cent of the news items covered value conflict (see Figure 3.4(c)). The media and public discourse shifted from a damage issue towards a safety issue from 2013. The use of a value conflict frame increased in 2013 and stabilized in 2014, followed by a further increase in 2015. Altogether, there was an increase of nearly 20 per cent in three years (2013, 2014, and 2015). Whereas before 2013 almost one in 10 news media reports was dedicated to disagreement between the interests of economic values and safety values, in 2015 almost one in three papers used this dramatization bias. This is interesting because, although of course these value conflicts are clear and important in this case, they basically did not change much over time. However, with the rising attention on the risks of earthquakes and the position of citizens, this value conflict became more prominent and interesting to report.

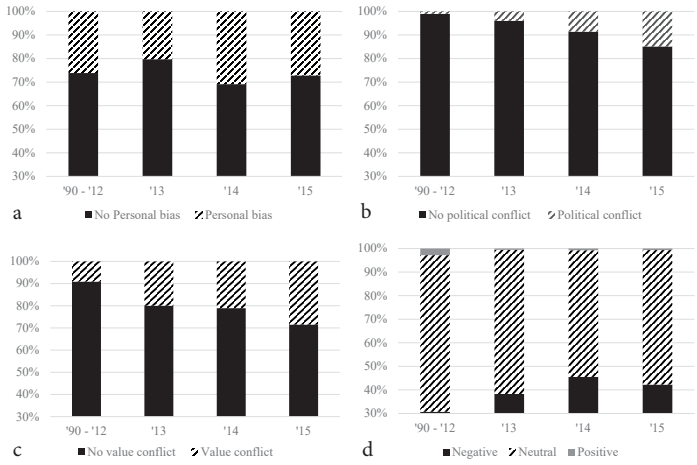


Figure 3.4: Percentage of biases used by media in different time intervals. Panel a: personalization, panel b: political disagreement, panel c: value conflict, panel d: negativity

Negativity

In the period between 1990 and 2012, the majority of news articles were neutral in their sentiment, i.e. they did not use a negative media frame. Around 30 per cent of the total news coverage used elements that indicate that the tone of the article was negative. Only a few articles were coded as positive (see Figure 3.4(d)). When the articles dealt with the topic of gas drillings, there was a lack of positive news reporting. After 2013, media became more negative in their reporting. In 2014, almost one in two of the many articles made use of negativity bias. In 2015, the effect reduced slightly, and the negative bias was less used than in 2014.

Differences between newspapers

The data show that sensational newspapers used more personalization bias than quality newspapers did (see 3.5(a)). Quality newspapers focused more on dramatization, in particular value conflicts (see Figure 5(b)). In 2014, the personalization bias was used to the same extent by all the newspapers. With *Algemeen Dagblad* (21 per cent), *NRC Handelsblad* (22 per cent), *Dagblad van het Noorden* (26 per cent), and *de Volkskr*ant (30 per cent), the newspapers are almost equivalent in the use of this frame, see Figure 3.5(a)). Only *de Telegraaf* (44 per cent) used the personalization bias significantly more. This shows a

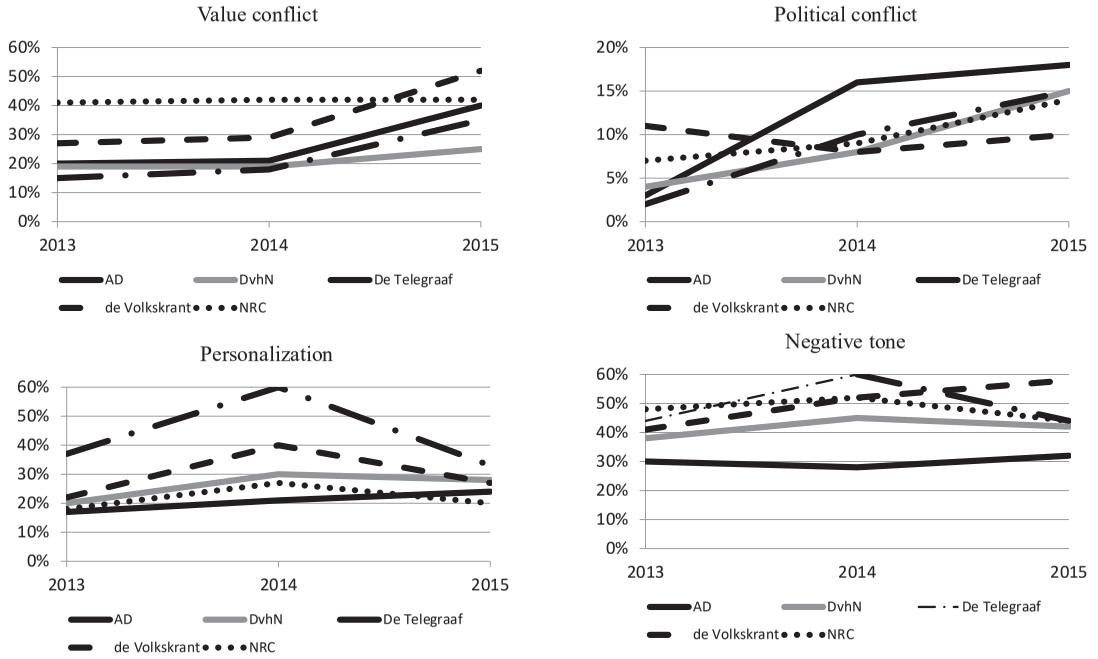


Figure 3.5: Biases in different newspapers

difference between this sensational newspaper and the quality newspapers in its use.

The use of political disagreement is relatively low in comparison to other biases (see Figure 3.5(b)). The quality newspaper *de Volkskrant* had already started using political disagreement before 2013 in almost one in 10 articles. Other newspapers published less on the disagreement between political parties or individuals from political parties. There was a small difference (approximately 3 per cent) between the newspapers in their average use of narratives of the political disagreement from 2013 to 2015: *Algemeen Dagblad* (12 per cent), *de Volkskrant* (10 per cent), *NRC Handelsblad* (10 per cent), *Dagblad van het Noorden* (9 per cent), and *de Telegraaf* (9 per cent). From 2012 to 2015, *Algemeen Dagblad* had the strongest increase in the use of this bias, from less than 5 per cent to more than 15 per cent (see Figure 3.5(b)).

As shown in Figure 3.5(c), all the newspapers shifted from 2013 to 2014 in the use of value conflicts in framing their news, except for *NRC Handelsblad*. After 2013, there was a significant difference between the newspapers and their use of a value conflict frame. The quality papers used the value conflict frame more often than sensational newspapers did. *NRC Handelsblad* (42 per cent) and *de Volkskrant* (36 per cent) used the value conflict frame more often than *Algemeen Dagblad* (27 per cent), de Telegraaf (22 per cent), and *Dagblad van het Noorden* (21 per cent) did.

Negativity bias is most commonly used by all the media in framing the news about earthquake risk, as illustrated in Figure 5(d)). Only *Algemeen Dagblad* (30 per cent)

Percentage of biases used by national and local news media in different time intervals. Panel a: personalization, panel b: political disagreement, panel c: value conflict, panel d: negativity reported less negatively compared to the other newspapers. The other newspapers, *de Volkskrant* (50 per cent), *de Telegraaf* (49 per cent), *NRC Handelsblad* (48 per cent), and *Dagblad van het Noorden* (42 per cent), used negativity bias in almost half of their articles, but none of them increased or decreased the use of negativity over the years.

3.6. Conclusion and discussion

In most framing studies, news sentiment and content are coded using content analysis (Matthes, 2009). Human coding is, however, a

research-intensive process, and therefore much research focuses on a relatively small selection of news articles. By using SML, we were able to perform a longitudinal study of frame variation in media coverage over time. It was possible to answer the questions of how media, over time, pay attention to the risks of earthquakes as a result of gas drilling in The Netherlands; the news biases that dominate (and does this differ during the time period); and whether this differs for various newspapers.

3.6.1. Media attention unevenly distributed

Earthquakes were reported in The Netherlands around 1990 as a result of gas drilling. Although there have been earthquakes since 1990, and in 1993 researchers reported the relationship between the earthquakes and gas drilling, media coverage on earthquakes has been very limited. The media analysis of earthquake risk in The Netherlands indicates that the media played only a minor role in signalling the earthquake risk in an early phase (democratic function). In the years 2003 and 2009, a slight increase in the number of news articles can be seen compared with previous years, but these increases did not continue in subsequent years and are not proportional to the increase in actual earthquakes in the first decade of the twenty-first century. If media coverage is mainly a reflection of hazard, one would expect a major change in media coverage of earthquake risk in 2009, a year with many and stronger earthquakes. This, however, is not manifested in the media analysis. The absences of media attention are remarkable because media are seen as the most prominent information channel regarding risk communication for the general public. However, the lack of reporting and signalling of the slowly emerging earthquake risk is in line with Baumgartner and Jones' (2009) theory. The tone and content of the media reporting had been almost stable for a long period (1990–2012). Our conclusion could be that the media did not perform their watchdog role very prominently before 2012 and only became active after 2012, probably triggered by the publication (trigger event) of the SodM report in 2013. At the same time, 2013 was also a year with more and more intense earthquakes. Therefore, the result shows that the fluctuations in media attention can only partially be related to the actual earthquake hazard; the increased earthquake risk itself does not seem to be decisive in the enormous and rapid media attention shift in 2013. These data confirm our first hypothesis, i.e. that media reporting is disproportional to the actual risk event.

3.6.2. Biases and patterns in media attention

Again in agreement with Baumgartner and Jones is the fast disrupted shift in media attention on earthquake risk in 2013. Not only did the number of media reports increase dramatically, but also the framing of the news shifted. New specific information biases were consistently introduced by the media to reframe the news; this is also in agreement with scholars such as Entman (2007) and Baumgartner and Jones (2009). In particular, dramatization bias was introduced after 2012 to reframe the reporting. This suggests that media attention is also partly a result of media logic itself, as dramatization in particular may be used by media outlets to serve their readers. Our data seem to point to the conclusion that, once an issue has reached a certain critical mass and gained momentum, newspapers report more and more about it, and positive feedback mechanisms can be observed where media attention causes more new media attention (see also Baumgartner and Jones 2009 for this phenomenon). This seems to be an indication of the journalists following one another (the pack of journalist), but, as we have not interviewed journalists about their choices, we cannot prove this.

In that race for attention visible after 2012, all newspapers made use of personalization, dramatization, and negativity biases in their reporting on earthquake risks. This phenomenon of copying behaviour and the homogenization of content in order to reach a larger reader population has been reported before by scholars such as Entman (1993). Negativity is the most dominant information bias. This is not surprising because, whereas negativity concerns all kinds of topics, other biases are more forced to focus on certain topics, e.g. safety vs. money (value conflict), or political debate (political disagreement), or a story about a human (personalization). The second most dominant bias is personalization, followed by value conflict and political disagreement as dramatization bias, which occurs least in all the news media. This is consistent with what Bennett (2009) proposed when he highlighted the mediatization element. Interestingly, although negativity and personalization biases are often used by all the newspapers when they report about the gas drilling risks, our analysis does not show an increase in the use of these media biases in the period 2013 to 2015. Dramatization bias, particularly political and value conflicts, became much more prominent in news reporting however.

Our second hypothesis – that from the onset media increase their reporting disproportionally to the physical risk of earthquakes and that all newspapers may be expected to use more personalization,

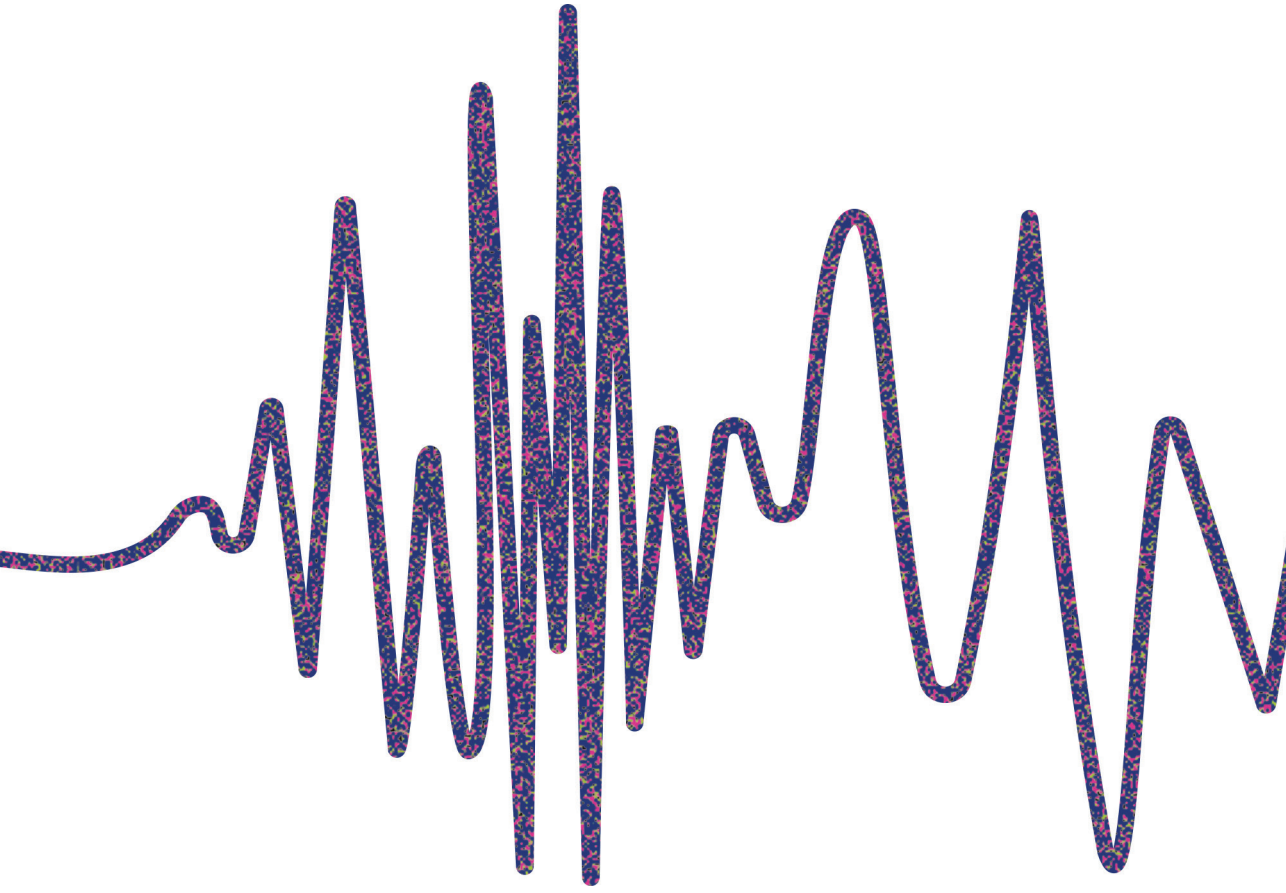
dramatization, and negativity biases – is thus not fully supported by our data. Actually, support for the hypothesis is found only for dramatization bias. Whether or not this is unique to Dutch gas drilling is unclear, and our second hypothesis deserves further study with other cases of developing public risk after the introduction of manmade technologies.

According to the literature, the use of biases can be explained by newspapers' different characters. From the literature, we expected a difference between sensational papers (*Algemeen Dagblad* and *de Telegraaf*) and quality papers (*de Volkskrant* and *NRC Handelsblad*) in the use of biases. H3, about more use of personalization and disagreement biases in sensational newspapers than in quality newspapers, is not fully supported by our data. Actually, for disagreement biases, the reverse is observed, i.e. more value conflict framing in the quality newspapers *NRC Handelsblad* and *de Volkskrant*. In the sensational newspapers, we see greater use of personalization bias. The sensational newspaper *de Telegraaf* reported almost twice as many personal stories as the other newspapers. It can thus be concluded that the expectation is partially supported. The use of negativity and political disagreement does not differ much between sensational and quality newspapers. They all report a lot of negative news, and all make limited use of the political frame.

3.6.3. Limitations and final reflections

This study has its limitations, an obvious one being that, although we covered a long period, we have analysed only one case. Further research should show whether the patterns that we have found also hold for other cases and especially other countries with different media landscapes. It is also clear that our coding cannot be disconnected entirely from the events and contextual situation of the case. Thus, we find more dramatization after 2013 and especially political disagreement, but we would also argue that political disagreement increases because of the massive media attention, which increases pressure on politicians. And, of course, machine coding has some disadvantages over human coding. SML was applied because of its reliably in coding (no human judgement) and of its time savings whereby an extensive analysis could be provided. Because it is a relative new technique and not often used in the social sciences, it was challenging to apply the technique. Therefore, this research was still very time consuming. Much more research is needed in the field of social and communication science to make SML an accessible technique for content analysis. Despite these limitations

however, we think that looking in the way we did in this article contributes to our understanding of attention patterns of media and their effects; and it shows the rapid changes in attention patterns and the way in which public risks are discussed. This makes decision making around these issues even more unpredictable and complex, as all actors involved in the issue will have to react to this changing media attention. In this way, media reframing of the news contributes significantly to the complexity of decision making about public risks, but also to the challenge for public managers and public officeholders to manage these processes. We may think that we observe biases in media attention, but those biases also generate political and policy attention and thus have positive effects. This is something into which we should be looking in more depth as it is a major part of political and policy processes.



Chapter Four: Dynamics and tipping point of issues attention in newspapers

Abstract

This study aims to contribute to the understanding of the dynamics and tipping points of issue attention in news media. The topic of this 25-year longitudinal study is the volume and the content of newspaper articles about the emerging risk of gas drilling in The Netherlands. We applied supervised machine learning (SML) because this allowed us to study changes in the quantitative use of subtopics at the detailed sentence level in a large number of articles. The study shows that the actual risk of drilling-induced seismicity gradually increased and that the volume of newspaper attention for the issue also gradually increased for two decades. The sub-topics extracted from media articles during the low media attention period, covering factual information, can be interpreted as a part of episodic frame patterns about the drilling and its consequences. However, a sudden major shift in newspaper attention can be observed in 2013. This sudden disjointed expansion in the volume of media attention on this large-scale technology occurred after a governmental authority classified the drilling-induced earthquakes as a safety issue. After the disjointed issue expansion, *safety* and *decision making* were the main subtopics linked to the thematic frames, *responsibility*, *conflict*, *human interest*, and *morality*. We conclude that SML is a promising tool for future analysis of the growing number of publicly available digitalized textual big datasets, particularly for longitudinal studies and analysis of tipping points and reframing.

This is an adapted version of the published article:
Opperhuizen, A. E., & Schouten, K. (2020). Dynamics and tipping point of issue attention in newspapers: quantitative and qualitative content analysis at sentence level in a longitudinal study using supervised machine learning and big data. *Quality and Quantity: international journal of methodology.*

4.1. Introduction

Media serve as the gatekeepers of information for the general public and fulfil an essential role by informing citizens about the risks and benefits of activities or situations (Shoemaker and Schäfer, 2009; Schäfer, 2012). Gruszczynski and Wagner (2017) argued, after an analysis of more than 400 media studies, that media coverage of a topic predicts citizens' attention on that same issue and raises awareness. Consequently, limited, or a lack of, media coverage may contribute to unawareness. For example, Kahlor et al. (2019) reported that citizens of Texas are mostly unaware of induced seismicity related to the extraction of gas and oil. Furthermore, Fisk, Davis, and Cole (2017) reported that the media coverage of this induced seismicity was limited for many years and that media frames emphasized the economic importance of oil and gas production, with little attention paid to the risk. However, in Texas, Ohio, and Oklahoma, hundreds of earthquakes (magnitude even over M=3 on the Richter scale) have been registered, and it has long been known that such earthquakes are a consequence of hydraulic fracturing (fracking) processes to stimulate oil production (Ellsworth, 2013). From a content analysis of the media coverage about carbon capture and storage, Boyd and Paveglio (2014) concluded that framing in media articles not only brings the issue to the attention of citizens, but also that it can affect public views and opinions – an issue that is particularly relevant for controversial emerging technologies.

In the present study, we focus on coverage of gas drilling and induced seismicity in newspapers in The Netherlands, an issue that became highly controversial in society and the political arena in 2013 (Opperhuizen, Klijn, & Schouten, 2019). News media coverage was limited for decades, but media attention expanded dramatically in 2013. In a previous analysis (see Chapter 3), we showed that the sentiment of newspaper articles changed substantially at this tipping point (Opperhuizen, Klijn, & Schouten, 2019). In an agenda setting study (see Chapter 5), we showed that the change in media reporting interacted with a change in the political debates about gas drilling and gas drilling policy (Opperhuizen, Schouten, & Klijn, 2019). In the present study, we aim to answer the question: *how do quantitative changes in the volume of media attention on emerging risks of earthquakes relate to changes in the content of media reporting at sentence level*? We study quantitative changes in journalists' use of particular subtopics at the detailed sentence level rather than headlines, paragraphs, or full articles. As we

collected over 2,000 media articles, the raw dataset at sentence level easily exceeded 120,000 entries. So, we created a big dataset for which human coding was realistically not feasible. As we wanted to study the subtle changes over time, both over the entire period of study and between specific years, we applied supervised machine learning (SML) to extract subtopics from the content of journalistic articles. Thus, we aim to show that this approach, as proposed by Margolin (2019), is fruitful in the communication field for analysing big data relating to observational content analysis without testing pre-formulated hypotheses based on human coding.

4.2. Analytical framework and approach

4.2.1. Framing and subtopics at sentence level

Matthes (2009), Hallahan (1999), Matthes and Kohring (2009), and Cacciatore, Scheufele, and Iyengar (2016) all argued that framing has different theoretical understandings and has been conceptualized and operationalized in various ways in the literature. According to Entman (1993), frames transform information about an issue and tell the reader which elements are meaningful according to the information provider. In this paper, we follow the sociological school of Gamson and Mondigliani (1987), where frames are the backbone of a storyline or a central idea that provides meaning. Furthermore, we adopt Lörcher and Neverla's (2015) terminology and use subtopic as the level below topic in newspaper articles. In the present study, the topic is the situation of gas drilling and its related induced seismicity. Individual subtopics do not entail all aspects of frames as defined by Entman (1993, p. 52) *in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation.* Subtopics emphasize mainly the *what* element in communications to audiences rather the *how* and the *why* of the issue. However, when subtopics systematically co-occur across a text in newspaper articles, they may be connected and be parts of a frame (Miller, 1997; Matthes & Kohring, 2009). In their work, Semetko and Valkenburg (2000) distinguished two kinds of frames utilized by the media to cover issues in the political arena. First, they identified episodic frames, referring to the description of the specific issue at hand. Second, in their article on media coverage of European politics, they identified five thematic frames utilized by TV and newspaper

journalists throughout the more than 4,000 stories that they studied. *Attribution to responsibility* was the most prominent generic frame that they identified, followed by *conflict*, *economic consequences*, *human interest*, and *morality.* In other studies, additional generic frames have sometimes been identified (Matthes & Kohring, 2009) or another sequence of the prominent thematic frames (Dan & Raupp, 2018).

Goffman (1974) argued that reframing can occur in media at any time when incongruent information becomes available and new meaningful elements arise about the situation or the issue. Previously, it was indicated that changes in media's issue attention do not usually follow a cyclical pattern (Lörcher & Neverla, 2015), as described initially by Downs (1972). In dynamic issue-attention studies in news media, increases in the number of publications are usually used as a quantitative measure. Reframing can be interpreted as a dynamic qualitative change in media reporting, meaning that the introduction of new subtopics sometimes leads to others being replaced. Stanyer and Mihelj (2016) presented an overview of typology and periods of longitudinal studies in three prominent communication and media journals. They concluded that there are very few studies researching changes over time and urged media and communication scientists to combine the strengths of quantitative and qualitative research to provide a more sensitive understanding of dynamics in communication. Dynamics should be understood here as temporal changes, as well as continuity, in reporting the frequency of an issue and its subtopics in newspapers. Longitudinal news media studies usually entail many articles and are prone to changes in linguistics as well as to changes in the writers of the content. Human-based coding of hundreds or thousands of articles is costly and time consuming, apart from many other methodological limitations such as the bias introduced by the human coders themselves (Van Gorp, 2007). Therefore, Su et al. (2017) suggested analysing sentiment and topics from (social) media datasets by using hybrid methods that combine human and computer techniques.

4.2.2. Content analysis with supervised machine learning (SML)

Content analysis of media reporting is usually carried out by human-based coding of particular words judged to be suitable for the relevant study (Lewis, Zamith, & Hermida 2013). Content analysis is nowadays often assisted by computer algorithms, enabling analysis of more significant numbers of newspaper articles through computer-based techniques (Riffe et al., 2019). The application of SML or other

human–computer hybrid models creates new opportunities to analyse the ever-growing amount of publicly available content from digitalized newspapers or other media outlets, platforms, websites, and social media for which content analysis based on human coding has created significant challenges (Weare & Lin, 2000). Walter and Ophir (2019) advocated the use of unsupervised machine learning methods using an inductive mixed-model computational approach. However, Su et al. (2017) reported that the strengths of human- and computer-based coding could be capitalized by applying supervised content analysis tools. SML is a relatively new technique that allows analysis of publicly available big data, which could hardly be analysed by applying traditional methods of content analysis (Weare & Lin, 2000; Lewis, Zamith, & Hermida, 2013). SML can bridge the gap between traditional thematic and automatic content analysis, according to Scharkow (2013). It is also a promising technique for longitudinal studies (Su et al., 2017). The hybrid, human–computer-based technique enables the computer to learn from a set of human-coded training documents (Zhang, Jin, & Zhou, 2010; Sebastiani, 2002). With SML, a modified type of inductive coding can be applied in cases where information is fragmented or where no results of previous studies have been generated that provide codes for content analysis (Elo et al., 2013). Some limitations of hybrid, human–computer-based techniques are also mentioned, as rules 'learned' and linguistic patterns of a particular study cannot be transported directly to another big data analysis. For every new study, a new human-coded training set needs to be developed. SML requires sufficiently large datasets because subsets of the dataset are needed as the corpus to train the algorithms in the machine learning approach (Kim et al., 2017). In longitudinal studies, the training set should sufficiently represent the various episodes of the whole period, because, otherwise, linguistic and other changes in the data providers may not be represented in the training set, thereby creating biased results during the final analysis.

4.3. Methods and material

4.3.1. Gas drilling case

We analyse the volume and the content of articles about gas drilling over 25 years in one local and four national newspapers. This case provided a compelling example to analyse the dynamics of issue attention in media and the changes in the content of reporting over a long period of time,

because the risk was an emerging risk. The fact that it was an emerging risk provides the opportunity to follow its development longitudinally in both media reports and actual risk events. In addition, this case is especially interesting because the negative consequences (earthquakes) appear at regional level, whereas the whole country benefits from the gas drilling. In the case of a local risk, media framing is extra meaningful, given that only people living in the region surrounding the risk get first-hand information about the risk, whereas others in the country depend on media reports; thus, media can play an important role in the dissemination of the risk, making it interesting to study.

Gas drilling has generated benefits of more than €280 billion for The Netherlands (Vlek, 2018) since it started in the 1960s. Earthquakes were a new risk issue in this region of The Netherlands, a risk that increased gradually during the last decades, both in strength and in frequency, as described in detail by Vlek (2018). In the northern part of the country, citizens had already been experiencing very mild earthquakes (up to M=3.5) for more than two decades. In August 2012, an M=3.6 earthquake struck the region. Then, in January 2013, the Dutch supervisory authority, State Supervision of Mines (SodM an inspectorate), stated that the emerging risk of earthquakes should be considered to be a safety issue and that a further increase in magnitude and adverse consequences could not be excluded (Dutch State Supervision of Mines, 2013). In the period that followed, no further increase in the magnitude of the earthquake risk was observed (Vlek, 2018).

4.3.2. Data collection

The newspaper articles were selected from the digital database LexisNexis NL. The research query used: *Gaswinning OR gasboring AND Groningen AND NOT Waddenzee*. Articles from five newspapers were selected for analysis: four national newspapers, *NRC Handelsblad*, *de Volkskrant*, *de Telegraaf*, and *Algemeen Dagblad*, and one local newspaper, *Dagblad van het Noorden*. The comprehensive newspaper database LexisNexis had articles available from 1990 to 2016 for the national newspapers but only articles from 1999 to 2016 for *Dagblad van het Noorden* because, before 1999, there is no digital archive publicly available for this newspaper. A total of 4,113 articles resulted from this selection. However, *Dagblad van het Noorden* has geographical variants – *North*, *South*, *East*, and *West* editions – leading to many duplicates. After the removal of duplicates, a final dataset of 2,265 relevant news articles resulted for the analysis.

4.3.3. Qualitative content analysis

The unit of analysis is a sentence, because this provides more detailed information than the headlines or an entire article and more context than single words. In total, 120,033 sentences were included for analysis. From the 2,265 news articles, a training set of 102 articles was selected, entailing 3,786 sentences (3% of the total) that were used for human coding. The sentences were inductively coded by two researchers. This generated subtopics for the labelled sentences (see Table 4.1). We included a subtopic in this study if the subtopic was present in more than 5% of the sentences. We chose this cut-off point, because the reliability of the predicted subtopics below 5% of the dataset decreased substantially.

In order to check inter-coder reliability, 5% of the body content was selected (Emmert & Barker, 1989). The reliability coefficient of Cohen's kappa was κ0.68, which is substantial, according to Landis and Koch (1977), and represents good observer agreement, according to Altman (1991).

Table 4.1: Codebook

Subtopic	Description	Examples
Safety issue	The sentences mention that earthquakes are a safety issue for people in the region; safety has to be the first priority ('safety first'); house renovations are necessary to prevent collapse or physical injuries to humans or deaths; or safety measures must be taken/have been taken.	*'Groningen people are in danger in their own house, when do the investigations provide clarity?'* *'But you cannot keep Groningen residents locked up in unsafe houses.'*
Decision making	The sentences refer to the number of policy decisions on gas production, or to a decision that should be made/has been made (by the Minister of Economic Affairs) to reduce or increase gas production.	*'The cabinet has decided to close the gas tap in Groningen again.'* *'At the beginning of this year, Kamp decided to reduce gas production at Loppersum by 80 percent.'*
Physical hazard	The sentences refer to the physical consequences of gas drilling, mentioning things such as land subsidence, an earthquake, progression in earthquake magnitude, or the direct link between cause (gas drilling) and effect (earthquakes).	*'The sharp increase in earthquakes is caused by more natural gas being extracted from the soil due to the cold winter.'* *'Gas extraction changes the natural balance in the soil, increasing the pressure along cracks in the earth.'*

Subtopic	Description	Examples
Material damage	The sentences focus on the physical damage in the region on houses, buildings, and heritage sites (like churches); on the number of damage claims; or on compensation after an earthquake or procedures for damage compensation.	*'Between 1997 and 2000, a total of 444 claims were awarded, with an amount of more than 800,000 euros [converted] being paid.'* *'There are new cracks in the walls.'*
Citizens' feelings	The sentences refer to citizens' feelings of anger, sadness, hopeless, fear, and worry; to people being so angry that they take to the streets to protest; to emotional consequences like depression, insomnia, and anxiety attacks; or to the decline or lack of trust and incomprehension of political choices.	*'He sees the anxiety on the faces of the inhabitants.'* *'They express their concern, anger, and fear at the many meetings about earthquakes in village houses and halls.'*
Research and advice	The sentences focus on the need for research, or on research about potential earthquakes and their consequences, or on research that has led to advice in favour of a decision (i.e. to reduce gas production).	*'The State Supervision of Mines recommends 40 percent less gas to be pumped up.'* *'A recommendation from the State Supervision of Mines states that gas extraction in the Groningen field must therefore be curtailed immediately.'*
Disadvantaged position of the region	The sentences address the negative and/or unequal consequence for the region or inhabitants of this region (compared) with other regions who mainly gain from the gas extraction.	*'If it had happened in the Randstad, the world would have been too small.'* *'Our province is pinched like the face of an adolescent.'*
Benefits	The sentences focus on the gas revenues for The Netherlands, i.e. mentioning billions of euro earned, or on the economic loss that a decline in gas production would cost the Dutch State. They highlight the importance of gas production from an economic perspective.	*'The consequences for the National Budget, spread over the next three years, are a total of 2.3 billion euros due to the reduction in natural gas revenues.'* *'This is injected with natural gas revenues of 11 billion euros annually.'*
International relations	The sentences refer to the import (mostly from Russia) and export of gas or refer to the position of the Dutch gas market in relation to other countries in Europe.	*'However, gas from Russia is sensitive and we are not becoming more independent.'* *'With an annual basis of 20 billion cubic metres of imported gas, to be supplemented with gas from the Groningen field.'*

Subtopic	Description	Examples
Apologies	The sentences capture the idea that the involved institutions should apologize or had already apologized for the damage caused by earthquakes and the lack of interest in protecting the local civilians against earthquakes.	*'I am going to say that I am sorry that thousands of people have been confronted with the effects of the earthquakes in Groningen.'* *'The big word is out: the government says "sorry" to the people of Groningen about gas extraction.'*
Communication	The sentences refer to the lack of communication messages from the involved institutions to inform citizens or to communication between citizens and institutions in general.	*'That is why we are screwing up communication.'* *'Consultation with residents took much more time than expected.'*
Gas supply	The sentences focus the amount of gas needed for the Dutch gas market or about the amount of gas that is still available for drilling in the Netherlands	*'Only in a harsh winter, if more gas is needed for warm feet, can gas up to 31 billion be extracted in Groningen.'* *Criticism of the minister is that the focus is on the security of gas supply.*
Safety vs. Cost	The sentences refer to the fact that there is, on the one hand, an economic benefit and, on the other hand, the risk of earthquakes.	*'It concluded there that safety up to 2013 was subordinate to the revenue from the Groningen gas, although it was already clear since 1993 that gas extraction caused earthquakes.'* *'Money cannot play a role when it comes to safety.'*
Governance structure	The sentences refer to the (changed) governance structure and the relationship between several public/private institutions or the distribution of (new) responsibilities, interdependencies, and power relations between the involved institutions. Also, all the sentences refer to 'the gas building' (in Dutch: *het gasgebou*w), which is the name of the risk governance network.	*'The Dutch government becomes the full owner of Gasunie's gas pipelines.'* *'It's a "closed and closed system"…focused on consensus.'*

4.3.4. Supervised machine learning process

Train model, predict codes, and evaluate performance

The 3,786 labelled sentences were exported from ATLAS.ti to XML documents, which formed the input for the SML (see Figure A4.1 in Appendix for the process). Frog is used to tokenize the original sentences (Van den Bosch et al., 2007). The sequential minimal optimization (SMO) algorithm embedded in the LIBSVM tool is used to train the support vector machines (Chang & Lin, 2011). The tokenized sentences are vectorized via the bag-of-words method (Zhang, Jin, & Zhou, 2010), which can be expanded with supervised machine procedures to include distributed word embedding (Rudkowsky et al., 2018). In this model, the order of the words in the sentence is no longer relevant; just the appearance of the words is essential. The bag-of-words model looks for the combination of all the words present in the bag, not just the presence of a single word. When possible, the bag-of-words model is complemented by other information derived from the text, such as sentiment information from dictionaries. However, SML algorithms use statistical methods and are not able to work with textual data as such. Hence, transforming the textual data into numerical data is a prerequisite. Processing steps are used to enable the conversion from textual data to numerical data that form the input for the SML algorithm.

Performance and reliability

According to Riffe et al. (2019), high reliability of a variable such as a subtopic indicates that it is manifest in the text, and such variables have higher reliability in comparison to full frames. In order to assess the performance of the employed algorithm, the labelled data (3,786 sentences) were split into a 90% (3,407 sentences) training set and a 10% (379 sentences) test set. Then, after training on the training data, the algorithm predicts the codes for the test data. Comparing the predicted codes against the manually assigned codes allows the computation of several performance measures. This process is repeated 10 times, as the split between the training set and the test set is random, and because of the relatively small number of labelled sentences. The performance measures are averaged to ascertain the accuracy of the employed method. Then, the standard deviation of these 10 performance measures is computed, as the spread between the 10 numbers gives a sense of how robust the results are. A low standard deviation

means that performance is not dependent on having a lucky split between training and test data.

The performance measures used are computed for each of the codes, as each has a separately trained classifier. Whereas intercoder reliability is used for human-based coding, precision and recall can be used to indicate the performance of human–computer-based coding. Precision measures how many of the predictions are correct. Recall measures how many of the manually labelled codes are predicted. Precision and recall are often in a trade-off relation, meaning that one can improve at the expense of the other. It is easy to have very high precision by predicting only the code for a couple of easy sentences. It is even easier to have a very high recall, by merely predicting that the code is present in each sentence. To compare performances, it is therefore convenient to combine these two numbers; this third measure is called an F_1-score. It is the harmonic mean of precision and recall, and thus combines both characteristics into a single number (see Table 4.2). A low value for either precision or recall weighs down the F_1-score considerably.

4.4. Results

We first discuss the results of the SML analysis, because the analysis itself is an important aspect of the study. Thereafter, the quantity of media messages in relation to the number of earthquakes is presented. Then, we present the content analysis, indicating the presence of the subtopics over time.

4.4.1. The media subtopics extracted with SML

In total, 120,033 sentences were included in the database to be analysed using SML. Each subtopic was generated independently of others, although more than one subtopic can originate from one sentence.

Accuracy and reliability

The performance measures used are computed for each subtopic generated from the training set. Each subtopic has a separately trained classifier (see Table 4.2). The analysis of newspaper coverage of gas drilling and earthquake risk from gas drilling generated 14 subtopics of content (see Table 4.1), based on codes that have a precision of over 0.8; this means that this prediction is more than 80% correct. The recall varies a bit more, as is usually the case for unbalanced datasets, ranging

Table 4.2: Subtopics' precision, recall, F1-Score, and St.dev. of F1-score

Code of the news item	Average precision	Average recall	Average F1-score	St.dev. F1-score
Safety issue	0.848	0.724	0.781	0.033
Decision making	0.863	0.680	0.761	0.060
Physical hazard	0.865	0.788	0.824	0.023
Material damage	0.857	0.689	0.764	0.039
Citizens' feelings	0.837	0.628	0.718	0.065
Research and advice	0.868	0.816	0.841	0.053
Disadvantaged position of the region	0.861	0.730	0.790	0.054
Benefits	0.856	0.721	0.783	0.044
International relations	0.848	0.756	0.799	0.056
Apologies	0.925	0.855	0.889	0.045
Communication	0.893	0.709	0.791	0.043
Gas supply	0.886	0.804	0.843	0.057
Safety vs. Cost	0.894	0.775	0.830	0.053
Governance structure	0.860	0.806	0.832	0.092

from 0.628 to 0.855. This means that the classifier has found between 62.8% and 85.5% of the sentences with a code.

The F_1-score then combines these numbers, and as this is the harmonic mean and not a normal average. The standard deviation in the next column is computed over the 10 F_1-scores for each code. In general, codes for data that are more unbalanced have a higher standard deviation. Also, codes that are more difficult for the algorithm to classify (e.g. citizens' feelings) have a higher standard deviation. However, the overall performance of the algorithm is robust, with standard deviations ranging from 0.023 to 0.065, and one outlier at 0.092 for governance structure.

4.4.2. Quantity of newspaper articles and the emerging risk

The total number of 2,265 newspaper articles about gas drilling in the Netherlands did not show an equal volume distribution of attention over the 25 years of study, see Table 4.3. Nor did the distribution of the total number of newspaper articles synchronize with the frequency or the strength of the earthquakes.

Table 4.3: Frequencies and magnitudes of earthquakes related to number of articles published in five newspapers in The Netherlands

Period	1990–2002	2003–2008	2009–2012	2013–2015
No. of earthquakes	133	209	297	311
Mean of earthquakes	10	35	74	104
Max. strength	2.7	3.5	3.6	3.2
No. of newspaper articles	94	138	100	1933
• *National*	39	42	34	711
• *Local*	55	96	66	1222
Mean newspaper articles	7	23	25	644
Ratio newspaper articles / Earthquakes	0.70	0.66	0.34	6.21
• *National*	0.29	0.20	0.11	2.29
• *Local*	0.41	0.46	0.22	3.93

In order to analyse the relationship between newspaper articles from local and national newspapers and the development of the risk over time in more detail, four periods are distinguished. Periods reflect either a substantive increase in the prominence of earthquakes (frequency or magnitude) or a change in the number of newspaper articles.

The first period ranges from 1990 to 2003, during which the annual frequency of earthquakes was relatively stable (a mean of 10/year) with no significant outliers. The actual hazard of every single earthquake in terms of strength was limited, with a magnitude within the range of 2.0–2.5 on the Richter scale. Although the risk events can be classified as relatively low, the permanence of earthquakes in the 1990s evolved into a new and chronic risk issue for the local community as a consequence of the gas drilling activity. As shown in Table 4.3, this new risk generated some media attention, with a mean of seven articles in a year, although this mean value underestimates actual attention because no numbers are available for the local newspaper before 1999. Despite this, the risk issue was only sporadically present in the newspapers. From 1999 onwards, the single local newspaper in the proximity of the gas drilling facilities had more coverage (55 articles in only five years from 1999 onwards) than the four national newspapers all together during the full period (39 articles all together in 14 years).

The second period is from 2003 to 2009, during which a substantive increase in earthquake frequency was registered, from a mean of 10 to a mean of 35 per year, and also with more earthquakes greater than M=3.

The most substantial earthquake had a magnitude of 3.5, 0.8 more than in the first period. The ratio between the annual number of articles and the number of registered earthquakes remained almost the same as in the first period, 0.7 in period 1 versus 0.65 in period 2. The increase in the volume of media attention is almost proportional to the increase in the earthquake risk. The local newspaper reported approximately twice as many articles as the four national newspapers all together (see Table 4.3). Interestingly, one of the national newspapers did not cover the gas drilling issue in this period at all.

In the third period, starting in 2009 and ending in 2012, a further increase in the frequency of the earthquake risk can be observed, from a mean of 35 to a mean of 74 earthquakes per year, as well as a small increase in the maximum magnitude up to M=3.6 in 2012. Despite this, the mean number of news articles per year hardly exceeded that of the previous period, and the ratio between the annual number of articles and the number of registered earthquakes dropped to 0.34. This third period can be characterized as a period of relatively high risk but relatively low media attention.

The fourth and last period is from 2013 onwards. In this period, the frequency of earthquakes increased further to 104 per year, but the maximum magnitude of the earthquakes was lower than in the third period. However, during this period, both local and national newspapers reported frequently about the risks of gas drilling, and the mean number of articles per year became more than 20 times higher than in periods 2 and 3. The ratio between annual articles and annual earthquakes increased to 6.2 as a result, from 0.2 to 4 for the local newspaper (20 times more) and from 0.1 to 2.3 for national newspapers (23 times more). The increase in the reporting about the issue by local and national newspapers is not proportional to the increase in the actual risk of earthquakes.

4.4.3. Subtopics utilized in newspaper articles over time

All 14 subtopics are identified in the four periods of the study. However, the distribution of subtopics is different between these periods (see Table 4.4).

In the first period until 2003, the subtopic *physical hazard* was most prominent and was utilized in the newspapers approximately 10 times a year at sentence level (see Table 4.4). In the second period (2003–2008), the annual number of publications increased more, approximately 3.5 times. The use of all subtopics increased at least threefold. *Physical*

Table 4.4: Subtopics registered in full dataset of sentences in newspapers during the four periods

	1990–2002	2003–2008	2009–2012	2013–2015
Safety issue	23	94	19	2170
Decision making	14	50	27	2044
Physical hazard	73	239	181	1496
Material damage	29	121	70	1600
Citizens' feelings	20	131	43	1299
Research and advice	14	79	16	687
Disadvantaged position of the region	9	73	9	596
Benefits	22	79	19	515
International relations	19	53	11	287
Apologies	9	37	8	279
Communication	7	40	5	266
Gas supply	8	39	5	240
Safety vs. Cost	5	36	6	165
Governance structure	4	42	4	119

hazard was the most prominent subtopic during this period also, although the increase in the use of subtopics was most prominent for *disadvantaged position of the region*, *communication*, and *governance structure*. *Safety*, *material damage*, *citizens' feelings*, and *benefits* were also subtopics in the second period, during which the actual risk of earthquakes increased substantially. In the third period, the annual number of articles was almost similar to that in the second period, and most subtopics were used less than in period 2. Only the use of *physical hazard* and *material damage* further increased in this period, during which the prominence of the actual risk also further increased. In period 4, after the Dutch SodM characterized gas drilling as a safety issue, *safety* and *decision making* became the most prominent subtopics used in the media, followed by *material damage* and *physical hazard*. Whereas the magnitude of the earthquake did not increase from period 3 to period 4, the use of *safety* increased 150 times and *decision making* 100 times. Also, the use of *disadvantaged position of the region* (88 times) and *communication* (71 times) increased more than the other items. Finally, although *decision making* became prominent in period 4, this is not observed for *governance structure*. Compared to period 2, for example, the annual use of *decision making* increased by a factor of approximately 92, whereas, for *governance structure*, this increase was only 6.6.

In the limited number of articles published in the first three periods, *physical hazard* is the dominant subtopic. *Physical hazard* is still a vital subtopic in the fourth period (1,496 hits), but slightly less than *material damage* (1,600 hits). During the first three periods, the number of hits for *material damage* was only half that for *physical hazard*. Until 2013, the subtopic *benefits* paralleled the use of the subtopic *safety issue*. It may be related to *gas supply* and *international relationships*. *Safety versus costs* was extracted by SML as a separate subtopic. This subtopic, as well as *research and advice*, are also parallel in all four periods.

4.5. Discussion and conclusions

In this study, we aim to answer the question: *how do quantitative changes in the volume of media attention on emerging risks of earthquakes relate to changes in the content of media reporting at sentence level*?

We first discuss the subtopics relating to episodic framing, followed by the subtopics relating to thematic framing, to build up to an overall answer to the question.

4.5.1. Subtopics relating to episodic framing

During the first three periods, the increase in earthquake risk was more or less proportionally reflected in the Dutch newspapers by an increase in the volume of publications. The content did not change substantially during the two decades and showed similarities with media reporting in the US about fracking-induced seismicity (Fisk, Davis, & Cole, 2017). In our study, we show that media utilized the subtopics *benefits*, *gas supply*, and *international relationships* to describe the economic perspective on gas drilling in The Netherlands, which can link to *physical hazard* and *material damage* as an adverse consequence. It may further link to the need for *research and advice* and *safety versus costs* evaluation. So, taken together and based on the description of the subtopics in Table 4.1, the media applied mainly an episodic frame to describe the economic activity in the northern part of The Netherlands. With regard to the definition of framing, according to Entman (1993), newspapers describe (at least partially) the problem and address the causal interpretation but do not address moral evaluation and/or treatment recommendations.

4.5.2. Subtopics related to thematic frames

In the fourth period, the subtopic *safety issue* dominates. *Citizens' feelings* also became an important subtopic. *Safety*, as well as *citizens' feelings*, refer to thematic frames identified by Semetko and Valkenburg (2000), such as human interest and conflict. The use of these subtopics may coincide with that of the subtopic *apologies*. This links to Semetko and Valkenburg's thematic frame of morality. The use of *apologies* shows an almost similar pattern and frequency as *communication*. After *safety issue*, *decision making* became the second most prominent subtopic in the last period, a subtopic that relates to Semetko and Valkenburg's *responsibility* – the decision in the Dutch case being to reduce or increase gas production. The subtopic *decision making* also points to the thematic frame *conflict* and disagreement about the policy and politics regarding gas drilling risk. This entails the need for alternative decisions and treatment. In contrast, the *risk governance structure* responsible for gas drilling-risk policy and politics received much less attention. Media in all four periods hardly use the latter subtopic, which shows the highest standard deviation in the SML analysis. Sentences addressing the morality of the subtopic *disadvantaged position of the local region* (Groningen) were initially covered mainly in the local newspaper but were also a prominent subtopic in the national media in the fourth period. Overall, during the fourth period, a disproportional increase in the usage of several subtopics, which can be linked to the thematic frames *conflict*, *morality*, *human interest*, and particularly *responsibility*, is observed. The thematic frame *economic consequences*, which dominated the first three periods, remained present as well as subtopics, and this links to episodic frames such as *physical hazard* and *material damage*. With the expansion of subtopics, a frame pattern can be constructed that is consistent with Entman's (1993) definition of framing, as the combination of subtopics covers the particular problem definition of the earthquake risk in The Netherlands, the causality between gas drilling and earthquakes, the moral evaluation aspects of human interest and risk and benefits, as well as (the need for) treatment of the earthquake risk issue.

We conclude that the media content was reasonably stable, and media utilized mainly episodic frames as described by Semetko and Valkenburg (2000). However, for the disjointed quantitative increase in reporting (in 2013), the actual risk was not significant. The tipping point in media reporting did not follow an increase in the risk. The

SodM's classification of a drilling-induced earthquake as a safety issue for society was the trigger. With the introduction of *safety* as an issue for society, drilling-induced seismicity became the responsibility of the government (Cvetkovich & Löfstedt, 2013); this supports the outcome of our previous study about the interaction between media, policy, and politics of gas drilling (Opperhuizen, Klijn, & Schouten, 2019; see Chapter 5). In the current study, we show that a governmental authority's classification of an issue as a safety problem for society can cause controversy in society, and this can be the source of the tipping point and the reframing of the content of media articles. It triggered media to introduce subtopics that can link to thematic frames in addition to episodic frames, as identified by Semetko and Valkenburg (2000). With the introduction of subtopics that link to the thematic frames, *responsibility*, *conflict*, *human interest*, and *morality*, journalists systematically and rapidly changed *what* was communicated to the audience about the issue of gas drilling and drilling-induced seismicity.

The emerging risk of earthquakes in The Netherlands was not covered in a timely fashion in the national media, thus leaving the general population almost unaware of the risk of gas drilling. An insufficient level of risk awareness among journalists may explain this, or it may indicate a lack of the minimum level of prominence required to achieve broadscale coverage by media, as postulated by Neuman (1990). We conclude that conflict and controversy did not play a role in the media stories for an extended period, and the absence of controversy may help to explain the low (or under-) reporting. This finding supports and adds to Boyd and Paveglio's (2014) study concluding that framing in media articles not only brings the issue to the attention of citizens, but also can affect public views and opinions – a situation that is particularly relevant for controversial emerging technologies.

This study shows that, from 2013 onwards, media attention increased in a disjointed manner when content no longer related directly to the prominence of the risk only, but to the controversy about risk and benefits. We conclude that gas drilling was no longer a technical question and that a controversial value-loaded issue marked the tipping point of the reframing. The trigger for the tipping point and reframing most likely was the SodM report in January 2013. This report introduced a value conflict by mentioning gas drilling as a *safety issue*. We conclude that, when gas drilling was introduced as a value conflict, media added emotionally loaded subtopics like *citizens' feelings, material damage*, and *disadvantaged position of the region*. This finding supports other

studies finding that journalists create eye-catching messages relating to human interest and added news value (Carslaw, 2008; Kitzinger, 1999). The expansion of emotionally loaded subtopics coincided with the change in the sentiment of the articles, as we have reported previously (Opperhuizen, Schouten, & Klijn, 2019).

In the process whereby more emotional items started to dominate the reporting, the beneficial aspects of gas drilling for society became relatively less important. *Decision making* is an appealing item for the media because it invites stakeholders' opinions and expressions of interest. The lack of *controversy/conflict* elements until 2013 may be a sufficient explanation of why national reporting was limited, whereas the introduction of the *safety* and *decision making* subtopics triggered the national media coverage. Consequently, intensified media attention on *safety* and *decision making* may stimulate the public discourse about the commitment, care, competence, and predictability of the government responsible for the safety of citizens (Neuman, 1990).

Gas drilling, as studied here, provided a compelling case to analyse the dynamics of issue attention in the media and the changes in the content of reporting over time. It may serve as an example for other media attention patterns for other benefit-risk issues related to man-made technological activities such as hydraulic fracking for oil and gas.

4.5.3. Conclusion and discussion on supervised machine learning

In the current study, SML was successfully applied to a big dataset to analyse the content of media reporting about the risk and benefits of gas drilling over 25 years. By training the computer algorithm with a limited corpus of data, a large set of sentences could be analysed with the bag-of-words approach. Overall, we find support for Scharkow's (2013) statement that supervised text classification, which uses algorithms from machine learning, has the potential to become the standard method for the quantitative and the qualitative content analysis of big textual data.

We conclude that subtopics extracted with SML in a longitudinal study can be successful for *frame mapping* (Miller, 1997) or to reconstruct *patterns* (Matthes & Kohring, 2009), mainly when such maps or patterns can be meaningfully interpreted with frames described in the literature and with episodic information on the issue being studied.

4.5.4. Limitations

The first limitation of this study is that the SML focused on print media. Data from other traditional channels like radio and television and also digital media are not part of this study, although these channels have an essential role in issue attention on emerging risk. Future content analysis of digital media and the comparison between digital and traditional reporting in the case of emerging risk is therefore needed. The second limitation relates to the design of the study, which focuses on the emerging risk of earthquakes. Wardman and Löfstedt (2018), for instance, argued that risk dynamics are context dependent. Hence, the outcomes of this study are not automatically valid for other types of risks and require further study.

First, the documents are cleaned so that they can be processed correctly in later steps. In particular, splitting the text into proper sentences can be challenging to do automatically, as a rule stating that sentences should end with a period or full stop does not always apply in news articles. For instance, headings are often not followed by a full stop, falsely giving the impression that the first sentence of the article directly follows the heading. Therefore, first, an extra empty line between the headline is inserted, and the first sentence is added to mark the difference. Another frequent formatting problem is the use of quotes, as the quote often ends after the period. This makes the full stop unnoticeable for the computer, and this also leads to the incorrect merging of two sentences.

The second step consists of running the documents through Frog (van den Bosch et al., 2007), a natural language pipeline for Dutch that extracts all kinds of linguistic information from the text. It gives the computer information about the text that would otherwise just be a string of characters. It splits the text into groups of characters that comprise words. These words group into sentences. After that, the words are categorized into word types (nouns, verbs) and labelled with their lemma (i.e. the dictionary form of the word). This step helps the algorithm to understand that different words can have the same meaning (be, are, is). Another difficulty of the Dutch language is that it is possible to form new words by combining two or more existing nouns. Humans easily recognize these compound nouns, but computers do not automatically recognize that a word is formed from two or more other words and hence see these compound nouns as entirely new words that are unrelated to their constituent nouns. This can be a problem because words with similar meanings will not be noticed as

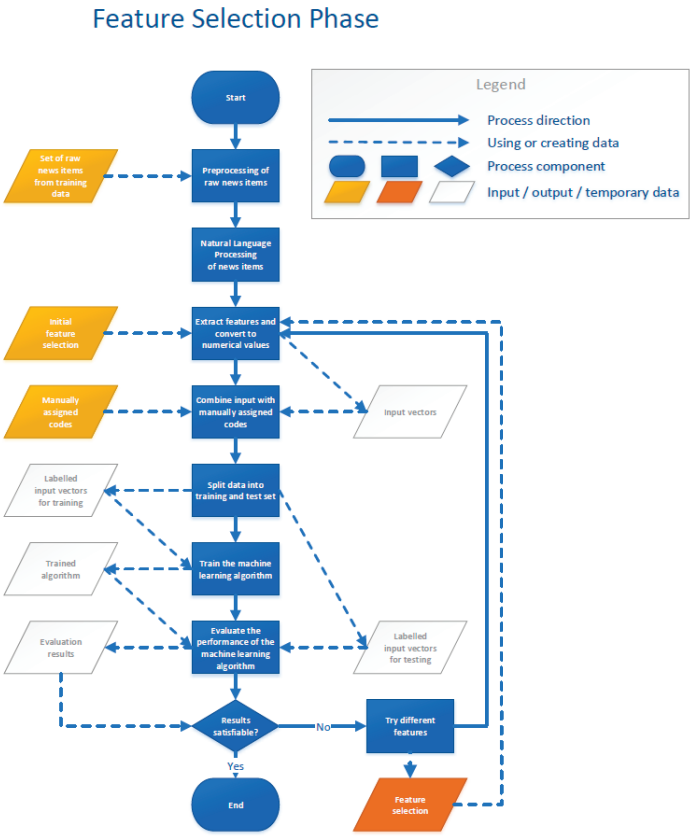


Figure A4.1: The machine leaning process - continued on the next page

similar by the algorithm. That is why compound nouns (e.g. aardbeving (earthquake), consisting of aard (earth) and beving (quake), are labelled with a list of their constituent nouns.

The third step is feature selection; this involves determining what pieces of information the algorithm can use to predict the codes. The bag-of-words model is the starting point of feature selection. This means that, for each unique word in the dataset, its presence or absence in the current sentence is recorded. For example, if the dataset contains 5,000 unique words, recording which words are present would result in a series of 5,000 zeroes and ones, where only the words that are present are given a 1, and the rest will remain a 0. Besides the words, the presence or absence of word types (e.g. nouns, verbs), named entities (e.g. names of persons, organizations, or places), and compound

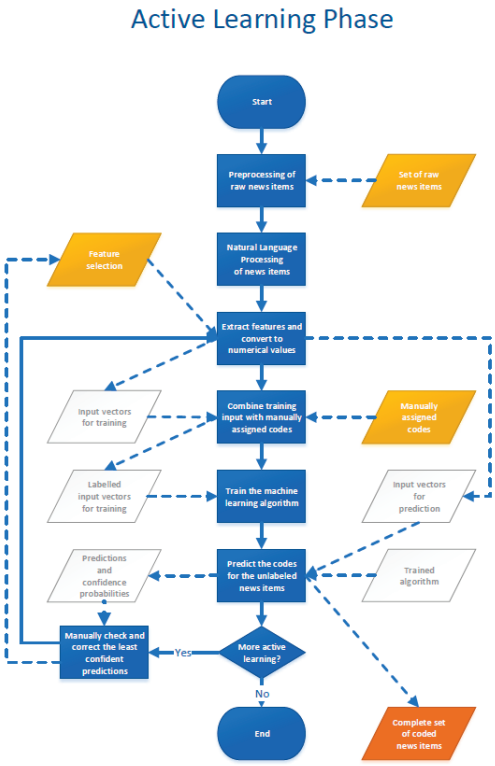
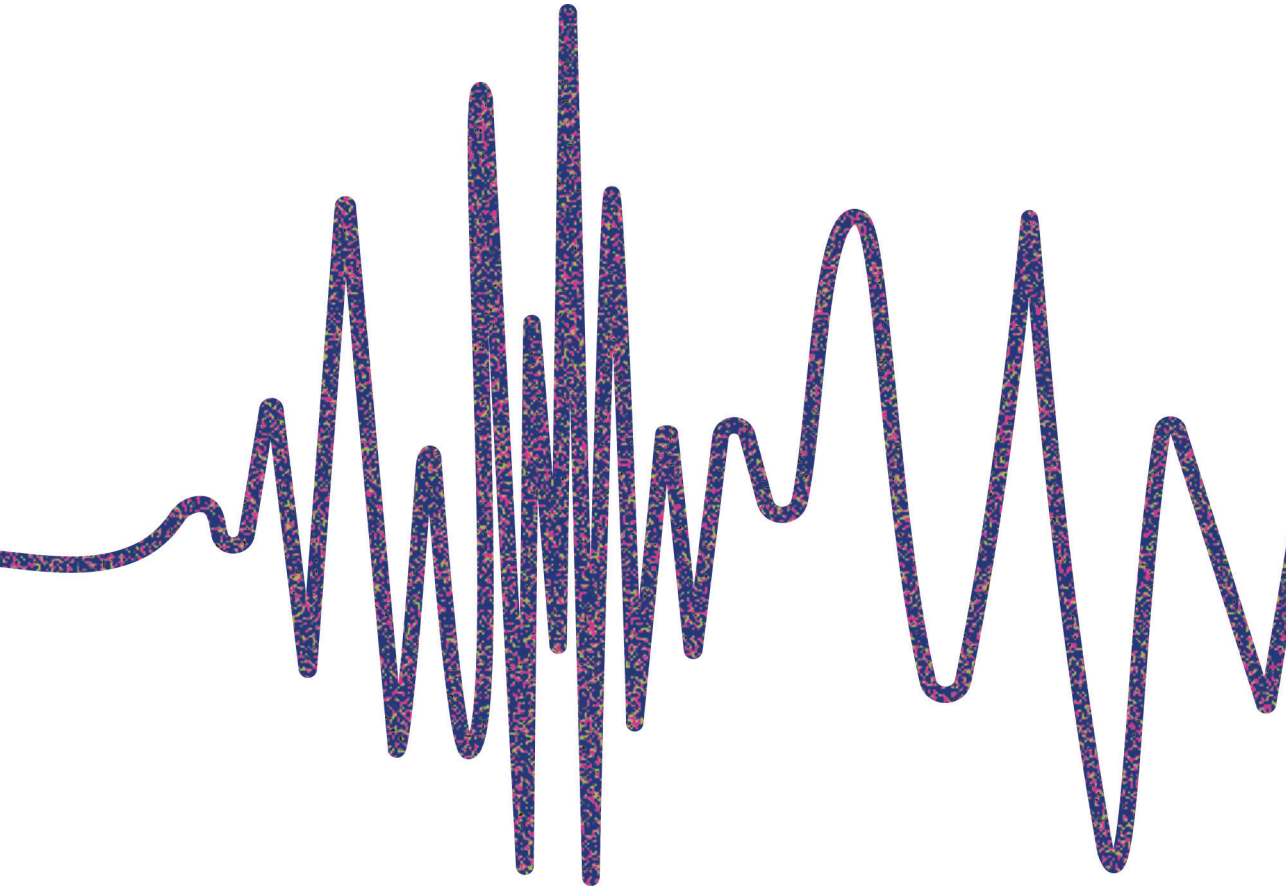


Figure A4.1: The machine leaning process, continued.

noun constituents are also recorded. Furthermore, by using a Dutch sentiment lexicon, six additional pieces of information, or features, are encoded: the number of positive words, the number of negative words, the number of objective words, the number of subjective words, the total sentiment score of all the words in the sentence, and the total subjectivity score of all the words in the sentence. It should be noted that all presence or absence features are binary, whereas these last six features are not.

The three steps transform the textual data into a set of numerical vectors, one for each sentence. After that, the dataset is divided into a training set and a prediction set. The training set consists of the manually coded sentences, and the prediction set contains all the other sentences. The SML algorithm used for this task is a support vector

machine (SVM) that has proved to be effective at text classification tasks (Suykens & Vandewalle, 1999; Tong & Koller, 2001). For each of the codes (Table 4.1), a separate SVM model is trained to predict, for each sentence in the prediction set, whether that particular code is present or not (see Figure A4.1). As particular codes may be more difficult to predict than others, the SVM model not only yields the final prediction but also assigns a probability to the two scenarios (i.e. present and absent). The more certain the algorithm is, the higher the probability is of one of the two scenarios. If the algorithm does not have any clue, the probability of a particular code being present will be 50%, the same as the probability of that code being absent. For each code, these low probability cases are again manually annotated to provide the algorithm with more training data. This process can be seen as performing one round of active learning to improve prediction accuracy.



Chapter Five: How do media, political, and regulatory agendas influence one another in high risk policy issues?

Abstract

This article shows how an emerging risk is covered by the media and how this interacts with political attention and policy implementation. Gas drilling has resulted in earthquakes in The Netherlands over the past 25 years. We show that an increase in their frequency and magnitude did not stimulate media attention. Media and political attention increased only after the media had interpreted the risk as a safety issue. Once this had happened, newspapers and political debates tended to focus on the emotion-loaded aspects. This contrasts with the regulatory agenda, which followed its own course by focusing on factual information. By using a new method – supervised machine learning – we analyse a large, longitudinal dataset to explore patterns over time. Our findings shed new light on risk- and agenda setting theory, confirming that media and politics agendas reinforce each other, but the regulatory agenda is not strongly influenced by them.

This is an adapted version of the published article:
Opperhuizen, A, E. Klijn, E.H. & Schouten, K. (2020). How do media, political and regulatory agendas influence one another in high risk policy issues?. *Policy & Politics.*

5.1. Introduction

In the social sciences, many scholars argue that media attention not only generates more public awareness towards a public risk issue (e.g. Kasperson et al. 1988; Renn, 1991), but also increases attention on the issue on the political and the regulatory policy agenda that may significantly influence decision making. The agenda-forming literature highlights the importance of media–government interaction (e.g. Cobb & Elder, 1983; Baumgartner & Jones, 2009; Downs, 1972; Kingdon, 1995). In the risk-analysis literature also, media play a key role in governance actions in response to risk events. Early risk-analysis schemas, such as Kasperson et al's. (1988) social amplification of risk framework (SARF), have a tendency to use overly simplified (and linear) models purporting to describe how media attention on risk influences political debates and governmental action.

5.1.2.Studying the dynamics of media attention

Howarth (2013) argues that media–government interactions are crucial to the trajectories of risk debates in society but that this is the weakest link in existing studies. This interaction is dynamic and complex, but important, because knowledge of how it works is essential for understanding the public and institutional response to particular risk events (Howarth, 2013). Even less is known about the role of media and media–government interactions in risk situations that emerge slowly over a long time. Thus, the central aim of our article is to analyse how risks are covered by the media and how this interacts with political attention on risks and the implementation of risk policy. We hope not only to contribute to a greater understanding of the dynamics of attention on risk, but also to enrich the debate by combining insights from various strands of literature and looking at some core assumptions.

The point of departure in this study, inspired by combining core insights from the risk literature (especially SARF), agenda-forming theory, and elements from mediatization theory, is that media attention can often not simply be explained by the physical nature (ontology) of the risk event, i.e. the prominence of the hazard and the likelihood of the event (e.g. Murdock et al. 2003). However, the (epistemological) risk response in society may be triggered by some elements of an ontological risk, as these may attract media or political attention in some, but not all, cases. As the literature on mediatization shows, attention is also influenced by media logic (Mazzoleni & Schultz, 1999; Bennett, 2009).

Media outlets function as gatekeepers of information for the general public and for politicians. Media select items that they think are interesting for their consumers (Shoemaker & Reese, 1996). Journalistic attention in turn may enhance risk awareness and perception, call for risk assessment action, and stimulate risk management decisions (Klijn, 2016). A media hype about a risk issue may also create heated political debates about risk governance, as is known from agenda theory (Cobb & Elder, 1983; Baumgartner & Jones, 2009). Thus, media do not function as neutral transmitters of risk events to fulfil their democratic role (e.g. Renn, 1991) but rather apply their own professional rules when they decide about the newsworthiness of a risk issue. Kepplinger and Habermeier (1995) and Vasterman (2005) go a step further and argue that, by applying mediatization elements, media themselves become part of the risk issue. Media hypes may be more attributable to the media's role than to the physical risk or event (see Wirz et al. 2018).

5.1.2. Research questions

In this study, we analyse the dynamics between media attention, political debates, and the regulatory policy agenda over 25 years of gas drilling and resulting earthquakes in The Netherlands. Three questions informed our research: 1. How does the prominence (frequency and strength) of the risk becomes manifest on the media agenda? 2. How do the media, political, and regulatory policy agendas address the risks and benefits of gas drilling? 3. How do the three agendas interact with one another over time?

The expectation is that prominent earthquakes will be reported by media, although it is unclear what 'prominent' means for media and what triggers a change in the volume and content of reporting. In addition, the expectation is that increased media attention will influence the political agenda and the regulatory policy agenda, as emphasized by agenda theories. However, to unravel more precisely both the subtopics covered on the three agendas and their dynamics over time, a longitudinal analysis of the content of media articles, debate transcripts, and regulatory reports on the relevant issues is required. For this, we used a relatively new technique: machine learning, whereby the computer codes vast numbers of documents based on human-coding input. The method is explained in greater depth in section 5.3 on methods. In section 5.1.3, we discuss the case and in section 5.2 the theoretical framework used to analyse the data. The results are presented in section 5.4. In the final section, we discuss the main findings and their implications.

5.1.3. Earthquakes and gas drilling in The Netherlands

In 1959, a gas field was discovered in the Province of Groningen. Since then, gas has earned more than €250 billion in financial benefits for the Dutch state. The energy is used by Dutch households, businesses, and industry (Vlek, 2018). The financial benefits were for some time deemed to outweigh potential negative side effects, such as land subsidence. In 1990, the earth began to tremble in the northern part of The Netherlands as a consequence of the gas extraction (Van Thienen-Visser & Breunese, 2015; Vlek, 2018), a causality that has been confirmed by the Dutch State Supervision of Mines (SodM). The first earthquakes were relatively light (<*M*=3.0 Richter scale), but gradually the damage to buildings increased. These earthquakes are the unexpected result of manmade policy choices.

Public opinion on gas production policies changed considerably after an *M*=3.6 earthquake hit the village of *Huizinge* on 16 August 2012 (Vlek, 2018). This particular earthquake was only slightly stronger than the earthquakes in 2006 (*M*=3.5) and 2008 (*M*=3.2), but exceeded the previously set indicator value for safety of 3.5. Officially, there were and are no safety limit values in The Netherlands. In the first report about earthquakes in 1995, it was argued that *M*=3.3 was probably the upper limit, and later reports suggested *M*=3.9 (Van Eck et al, 2006). For a long time, it was assumed that such upper limit could cause no – or only very limited – damage, and definitely no direct victims. For SodM, which still assumed that *M*=3.9 was the upper limit, this earthquake was a key event forcing earthquake risk to be addressed as a safety issue. SodM advised the Ministry of Economic Affairs to initiate a reduction in gas production. The minister postponed his decision until 2014. Gas production became a subject of heated public and political debate, focusing on the legitimacy of the production policies and the actors responsible (Green-Pedersen & Mortensen, 2010). The Dutch government decided to significantly reduce gas drilling and to terminate it by 2030 (Perlaviciute et al. 2018).

5.2. Theoretical framework

Agenda-forming concepts in social sciences focus on how specific issues reach and remain on the political agenda. Schattschneider (1975) postulated the *conflict expansion* theory, an idea further elaborated in Cobb and Elder's (1983) classic study on agenda forming. In their view,

the role of mass media is very important in the process of creating wide recognition and awareness of a policy issue. They stress that one of the core strategies deployed by actors to get issues onto the agenda is to expand the issue to a larger public by increasing media attention. The relationship between media and both political attention and actual policy change is a subject of scientific discussion. Whereas some authors argue that the media usually dominate the political agenda (Stömbäck & Nord, 2006), others argue that politicians are more in charge (Van Aelst et al, 2014). In their general overview article on agenda-forming research, Walgrave and Van Aelst (2006) found that roughly half of the studies in their research displayed strong effects of media dominating the political agenda, whereas the other half displayed only limited or no effects. We therefore expect the following:

> **Expectation 1**: More media attention on a topic will generate more attention on the political agenda and the regulatory policy agenda.

5.2.1. *Amplification and framing of risks issues*

Risks are not only techno-scientific issues. They can be perceived differently by individuals, groups, and communities, as they are prone to subjective cognitive and cultural elements (Taarup-Esbensen, 2019). Media attention influences awareness and perception of, and attitudes to, risk at individual and at societal level (Kitzinger, 1999). The link between risk issues or events and political and regulatory policy agendas is extensively theorized in SARF (Kasperson et al. 1988), in which the techno-scientific assessment and the social experience of risk are integrated. SARF is a useful framework because it helps to understand and predict the impact of risk information on society (Duckett and Busby, 2013). It focuses on amplification stations such as opinion leaders, social groups, government agencies, voluntary organizations, and last but not least news media that influence risk awareness and attitudes among the general public and contribute to the further development of the risk as a social construct. SARF proposed two stages, the *social amplification* stage of information transformation and the *ripple effects* stage, which refers to response mechanisms in society and politics (Kasperson et al. 1988). In the amplification stage, two extreme outcomes can be anticipated: 1. an event or risk issue that is declared a high risk in an expert risk assessment receives little public attention: this is referred to as *attenuation* of the risk; 2. a risk event or risk issue is declared a low risk

in an expert risk assessment, but receives a lot of public attention: this is referred to as *amplification* of the risk (Kasperson et al. 1988). Critically, in the amplification stage, risk events or issues may or may not obtain *signal value* for citizens (Wardman & Löfstedt, 2018). This means that the event or issue may or may not raise awareness and be perceived and designated as a meaningful risk for society (Kasperson et al. 1988). If it does, it emerges and obtains signal value, it '*accrues further social salience and significance as the circulation and flow of risk messages and images spreads through various channels and is filtered by "amplification stations*'" (Wardman & Löfstedt, 2018, p. 1806). The amplification or attenuation process influences how society, politicians, and institutions respond to risk signals. This is the second stage of SARF, during which risk as a social construct *ripples* towards other spheres in society, like the political arena or the economy. Regardless of the prominence of the risk issue or event, other individuals and groups are affected and perceive consequences (Kasperson et al. 1988; Wirz et al. 2018). Ripple effects can stimulate political and risk-governance action and lead to an organizational response and policy changes (Kasperson et al., 1988).

Baumgartner and Jones (2009) studied agenda setting mechanisms in their analyses of various risk-related subsystems of public policy. They claim that the course of policymaking is not gradual or incremental, but rather disjointed or episodic. Subsystems can be stable, existing in an equilibrium for long periods of time in the absence of key events that have signal value for the media. However, policymaking stability can suddenly become disjointed at a particular juncture. Policy can be 'broken' only when there is a pushing force and a signal that leads to a disjointed change. Combining the insights from SARF and Baumgartner and Jones, we can expect the following:

> **Expectation 2:** Without the social amplification of a risk issue or event, the policymaking in a technical subdomain dealing with risk will be stable for a long period of time, and attention on both the political agenda and the regulatory agenda will be limited.

5.2.2. Media attention and media logic as factors in the amplification of risk

Media significantly influence when, what, and how issues or events are discussed in the public arena (Schillemans et al. to be published). They contribute to what can be perceived as risky in the public sphere. Originally, the role of media was presented in SARF as a fairly linear

transmitter of information about the risk. This simplified representation of the role has been heavily criticized (Murdoch et al. 2003; Raupp, 2014; Bakir, 2010). Media select, decode, and recode the risk signals of events or issues before transmitting them, a process that is selective and subjective and influenced by professional media rules (e.g. Renn et al. 1992). Issues or events that media can select and frame to fit their own logic and attract readers represent *news value* for media (Altheide and Snow, 1979).

By using particular biases, frames, subtopics, and interpretations, media can influence how risk issues or events are discussed in the public sphere and how this affects political attention and attention on the regulatory agenda (ripples in the conceptualization of the SARF model; see also Renn et al. 1992; Cobb & Elder, 1983; Klijn, 2016). News value thrives on issues that include emotions (Bennett, 2009) and relate to people's risk perception and attitudes, like anxiety and fear (Renn et al. 1992; Dunwoody & Neuwirth, 1991). Proximity and surprise also contribute to the news value of risk events and issues (e.g. Shoemaker & Reese, 1996). On the basis of this literature, we can expect:

> **Expectation 3**: During amplification of a risk issue or event by media, emotion-loaded subtopics play an important role in media attention.

However, it is unclear to what extent mediatization of risk information leads to a response on the political and the policy agendas. The complexity, longevity, and limited accessibility of policymaking explain why there is a '*paucity of research into the media's role in building policy agendas in risk issues*', according to Bakir (2010, p. 8).

5.2.3. Dynamics between media, politics, and regulatory agenda

In line with the previous observations, Binder et al (2015) distinguish two factors that determine media attention towards a risk issue or event over the course of time:

(1) The first factor affecting media interest in a risk is a change in the *prominence* of the risk. Prominence refers to the factual aspects of a risk, such as the frequency or strength of earthquakes.
(2) The second factor affecting media attention on a risk is a change in the *news value* of the event or issue (Binder et al. 2015;

Kepplinger & Habermeier, 1995). News value refers to the social element of the risk such as involuntariness, lack of control, inequity, and human interest (Kasperson et al. 1988).

Thus, given the SARF model and the two factors formulated by Binder et al (2015), we would expect:

> **Expectation 4:** When prominence is high but news value is low, the emerging risk will be attenuated by the media.

5.3. Research method: supervised machine learning

In order to investigate the dynamics between media, political, and regulatory policy attention on earthquake risks, we conducted a longitudinal content analysis by applying supervised machine learning (SML). This is a relatively new content analysis technique in the subdisciplines of agenda setting and risk analysis. With SML, larger amounts of data can be handled than can be practically done by classical human coding. In addition, longitudinal datasets covering long time periods can be handled; it is therefore a suitable technique for studying discourse over time (Chong & Druckman, 2010). SML is not a technique that employs only a predetermined code book to find specific words, equivalents, or specific word combinations. In SML, the computer 'learns' from a set of human-coded training documents and develops algorithms based on that. The training dataset must be large enough for training. Unfortunately, hitherto no procedure or minimal requirements are available to specify the size of training datasets. Given the large number of sentences analysed in the present study, an automated way to code and process content subtopics was required. Manually coding many thousands of sentences was simply not feasible. The SML steps are described in more detail in Appendix 5.A. The analyses were performed in *MATLAB R2018b*.

5.3.1. *Data sources*

In this paper, three sources of textual data are utilized: media articles, transcripts of political debates, and annual reports of the State Supervision of Mines (SodM). Thus, these datasets are a proxy for attention on the three agendas (newspapers as proxy for attention on the media agenda, political debates as proxy for attention on the political agenda,

and the SodM reports as proxy for attention on the regulatory agenda). The analysis covers the years 1990 to 2015. The year 1990 was chosen as the starting point for the analysis because this was the first year that earthquake risk was officially reported.

The first data source consisted of media articles. Articles from five newspapers: *Dagblad van het Noorden* (a locally oriented newspaper), *NRC Handelsblad* (a centre-right quality newspaper), *de Volkskrant* (a centre-left quality newspaper), *de Telegraaf* (a right-leaning sensational newspaper), and *Algemeen Dagblad* (a non-politically orientated sensational newspaper) were selected for analysis. The query '(*Gaswinning OR gasboring) AND Groningen AND NOT Waddenzee*' was entered in the digital archive LexisNexis. The archive had the news articles from the *Dagblad van het Noorden* only from 1999 onwards. This led to missing information from that newspaper for the years 1990–1998. A total of 4113 articles were found based on the query. Because *Dagblad van het Noorden* has multiple editions (*North*, *East*, *South*, and *West*), after removal of the duplicates, a final set of 2265 media articles remained. These formed the input for the content analysis of media reports.

The second data source consisted of transcriptions of political debates, extracted from the official archives of the Dutch parliament. With the query '(*Gaswinning OR gasboring) AND Groningen*', a set of 126 debate transcriptions was retrieved for the period 1990–2015. Twenty-one so-called *incoming documents*, comprising a list of numerical references to other external documents, were removed from the dataset. This resulted in a total of 105 political documents used for analysis.

The third data source consisted of a set of regulatory documents, 25 annual reports, published yearly by SodM. The regulatory reports were all human coded and were not used as input for the SML technique, because this textual dataset was too small for reliable predictions and therefore unsuitable for SML content analysis. We are aware that SodM publications do not cover the whole regulatory policy agenda.

5.3.2. Coding

For each year, we selected a random sample proportional to the total number of documents in that year for human coding of the training dataset. We selected a total number of 102 media articles and 32 political documents to code by hand for the entire timespan. Then, we determined the coding units at sentence level as we aimed for an analysis at subtopic level. In the second step, we extracted the subtopics

Table 5.1: Codebook

Subtopic	Description
Safety issue	The sentences mention that earthquakes are a safety issue for people in the region; safety has to be the first priority ('safety first'); house renovations are necessary to prevent collapse or physical injuries to humans or deaths; or safety measures must be taken/have been taken.
Decision making	The sentences refer to the number of policy decisions on gas production, or to a decision that should be made/has been made (by the Minister of Economic Affairs) to reduce or increase gas production.
Physical hazard	The sentences refer to the physical consequences of gas drilling, mentioning things such as land subsidence, an earthquake, progression in earthquake magnitude, or the direct link between cause (gas drilling) and effect (earthquakes).
Material damage	The sentences focus on the physical damage in the region on houses, buildings, and heritage sites (like churches); on the number of damage claims; or on compensation after an earthquake or procedures for damage compensation.
Citizens' feelings	The sentences refer to citizens' feelings of anger, sadness, hopeless, fear, and worry; to people being so angry that they take to the streets to protest; to emotional consequences like depression, insomnia, and anxiety attacks; or to the decline or lack of trust and incomprehension of political choices.
Benefits	The sentences focus on the gas revenues for The Netherlands, i.e. mentioning billions of euro earned, or on the economic loss that a decline in gas production would cost the Dutch State. They highlight the importance of gas production from an economic perspective.
Research and advice	The sentences focus on the need for research, or on research about potential earthquakes and their consequences, or on research that has led to advice in favour of a decision (i.e. to reduce gas production).
Communication	The sentences refer to the lack of communication messages from the involved institutions to inform citizens or to communication between citizens and institutions in general.
Governance structure	The sentences refer to the (changed) governance structure and the relationship between several public/private institutions or the distribution of (new) responsibilities, independencies, and power relations between the involved institutions. Also, all the sentences refer to 'the gas building' (in Dutch: *het gasgebouw*), which is the name of the risk governance network.

for our coding. The exploratory and descriptive purposes of this study required coding schemes to be developed inductively, i.e. we did not make use of a predetermined codebook, see Table 5.1.

The data from the selected media articles and political documents were coded by two researchers, and an intercoder reliability test was performed (Kaid & Wadworth, 1989). All political sentences in the training set were verified by the researchers to ensure the reliability of the political data. The first measure used is precision, which measures how many of the subtopics are correctly addressed by SML in the training set (Figure 5.1). The second is recall, which measures how many of the manually coded subtopics have been predicted by SML. Currently, there is no clear guideline about handling reliability and recall, so it varies per case.

$$\frac{\text{Correctly predicted codes}}{\text{Correctly predicted codes + Incorrectly predicted codes}}$$

$$\frac{\text{Correctly predicted codes}}{\text{Correctly predicted codes + Missed codes}}$$

Figure 5.1 Precision (left) and recall (right)

5.3.3. Reflection on supervised machine learning as research technique

Using the content of newspapers and transcripts of political debates about risks and benefits of gas drilling and earthquakes in The Netherlands generated large databases that could be successfully analysed by SML. The Dutch language, which has its difficulties for SML (Boiy & Moens, 2009), was not a fundamental problem in the study. The quality of the results in terms of variability, recall, and precision cannot be assessed however. For human coding, there are intercoder variability guidelines, but SML still lacks comparable guidelines. The set of 105 transcripts of parliamentary debates was sufficiently large to apply SML, although the much larger dataset of newspaper articles gave better precision and recall results. The study also illustrated that large datasets are required to train the machine algorithms, as the smaller database of the regulatory authority's 25 annual reports was not large enough to do so. A clear guideline for the cut-off is not available and may be dependent on the nature of the data. Smaller datasets still require manual coding, but human coding is also required on a training set to train the computer algorithm. SML produces consistent subtopics that do not shift over the course of annotating. Therefore, SML was suitable

for the longitudinal analysis of content. The downside, however, is that the data need to be consistent. The algorithm 'learns' by looking at word occurrences, so if the word usage suddenly changes – for example because data from a very different sources are used – the algorithm will not perform as well as it would for a homogeneous dataset. The Dutch language usage in the datasets of newspaper articles and parliamentary debates probably differs because they serve different objectives and audiences. This may help to explain the (limited) differences in recall and precision in the datasets of media articles and political debates. In spite of this limitation, subtopics extracted from newspaper articles showed clear correlations with political transcripts.

Finally, although Scharkow (2013, p. 762) argued that '*Supervised text classification, which uses superficial statistical algorithms from machine learning, has the potential to become a standard method for quantitative content analysis*', applying SML in social science research is still in its exploratory phase. The method is very time consuming – for example, to discover the types of documents that are more or less applicable for SML analysis – and the lack of guidelines about recall and precision, sample size, sizes of training sets, and language differences makes SML and other machine learning approaches prone to negative critiques. We recommend focusing on research on the capabilities and limitations of SML and its practical application and developing guidelines for application.

5.4. Results

5.4.1. Prominence of the risk and media, regulatory policy, and political attention

We start with the relation between the prominence signals of the risk of earthquakes (frequency and strength of the earthquakes) and the extent to which these signals are manifest on the media, policy, and political agendas. The results show that there were more than 20 earthquakes already registered in 1994 (Figure 5.2). Neither the rapid increase in frequency to over 40 earthquakes in 2003 nor the increase in the maximum strength of earthquakes generated more media reporting (Figure 5.2) or political attention (Figure 5.3). SodM reported earthquakes from 1991 onwards, but until 2000 almost no attention was given by Dutch parliament to the early signals of earthquakes. Neither did further increases in frequency – to almost 80 earthquakes in 2009

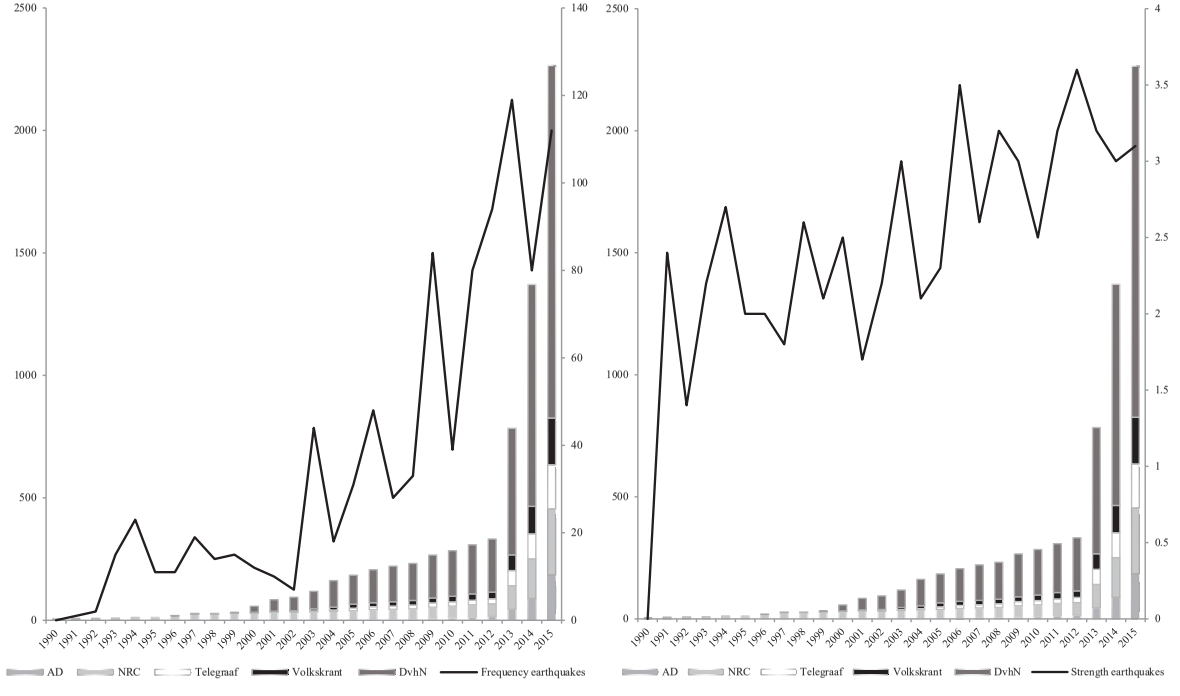
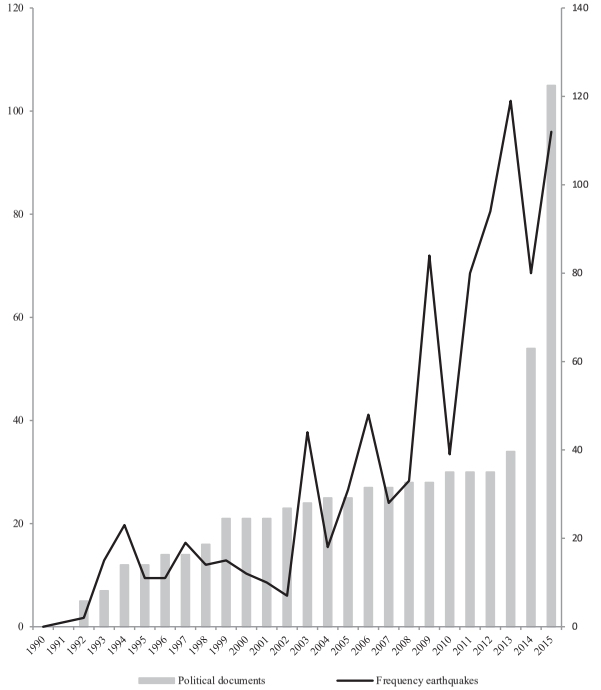


Figure 5.2: Prominence of earthquakes and media attention
*Panel a: earthquake frequency (right-hand axis) and newspaper attention, Panel b: strength (right-hand axis) and newspaper attention (left-hand axis)



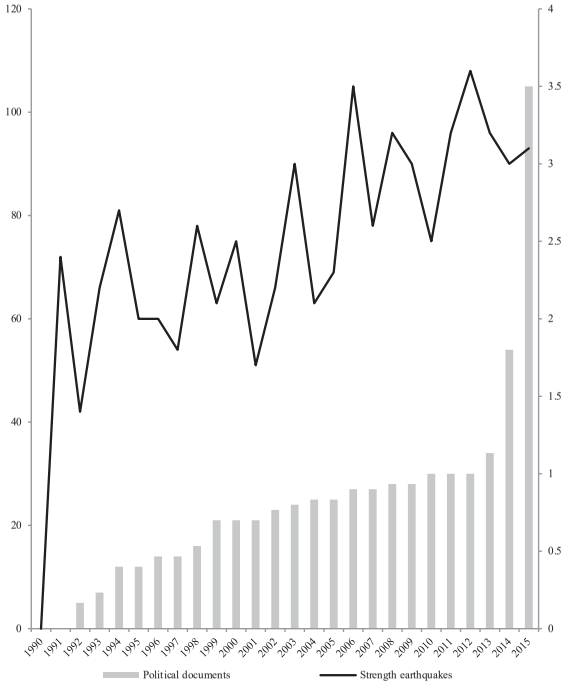


Figure 5.3: Prominence of earthquakes and political attention
* Panel a: earthquake frequency (right-hand axis) and political documents, Panel b: strength (right-hand axis) and political documents (left-hand axis)

Table 5.2: Mean rank differences of the subtopics on earthquake strength

	Media		Politics		Regulatory policy	
	Kruskal-Wallis H	Monte Carlo Sig.	Kruskal-Wallis H	Monte Carlo Sig.	Kruskal-Wallis H	Monte Carlo Sig.
Safety issue	3,535	.317	3,310	.366	11,273	.002*
Decision making	6,385	.063	2,468	.526	0,807	.879
Physical hazard	14,117	.000**	3,038	.442	2,174	.587
Material damage	10,499	.003*	2,346	.570	3,419	.331
Citizens' feelings	7,927	.022*	4,705	.248	3,711	.278
Benefits	5,771	.093	5,750	.089	4,929	.149
Research and advice	6,937	.043*	2,708	.484	9,474	.006*
Communication	8,305	.017*	4,013	.248	1,923	.661
Governance structure	6,035	.078	4,452	.203	5,348	.116

df.= 3; ** p<.01; * p<.05

and almost 100 in 2012 – accelerate attention on the emerging risk on the media or the political agenda. It was only after 2012 that both media and political attention increased, and this continued in 2014 and 2015.

In addition, we performed independent sample Kruskal-Wallis tests (Table 5.2) for each of the subtopics on each agenda. This test was chosen because the subtopics mentioned on each agenda are exclusive: if a subtopic is mentioned, no other subtopic is considered. The test shows that, for the media agenda, the subtopics *communication*, *citizens' feelings*, *material damage*, and *physical hazard* have a significantly higher ranked mean associated with earthquake strength than other subtopics. The political agenda does not show any significant results. For the regulatory policy agenda, the subtopics *research and advice* and *safety issue* are significant.

Thus, our expectation that media and political attention would be connected by prominence cannot really be confirmed.

5.4.2. Subtopics used by the media, the political, and the regulatory policy agendas

From the 2265 newspaper articles relating to the gas drilling issue, we extracted 14 subtopics. Nine of these 14 subtopics were also identified in the parliamentary debates and in the SodM annual reports

Table 5.3: Total number of the nine subtopics on the media, the political, and the regulatory policy agendas

	Media agenda	Political agenda	Regulatory policy agenda
1	Safety issue (2306)[a]	Benefits (2092)	Physical hazard (479)
2	Decision making (2135)	Safety issue (1242)	Research and advice (297)
3	Physical hazard (1989)	Material damage (1193)	Decision making (182)
4	Material damage (1820)	Decision making (1122)	Benefits (101)
5	Citizens' feelings (1493)	Communication (1050)	Material damage (93)
6	Research and advice (796)	Governance structure (1017)	Governance structure (85)
7	Benefits (635)	Citizens' feelings (1002)	Communication (80)
8	Communication (318)	Research and advice (570)	Safety issue (77)
9	Governance structure (169)	Physical hazard (423)	Citizens' feelings (27)
Total	**11661b**	**9812**	**1421**

[a] For example, 2306 sentences are coded with *safety issue* as a subtopic in the media articles.
[b] The total number (last row) is 11,661 sentences (100%). This formed the total media content. The 2306 sentences referring to the *safety issue* subtopic comprise 19.8% of the total.

(Table 5.3). The remaining five subtopics *safety versus cost*, *disadvantaged position of the region*, *gas supply*, *apologies*, and *international relationships* did not overlap with subtopics in either the political debates or the regulatory documents.

The analysis shows similarities (especially between media attention and political attention) but also differences. The SodM agenda focuses mainly on providing information about the *physical hazard* itself, on *research and advice*, and on *decision making*. The political agenda in contrast focuses mainly on the beneficial side of the technological

Table 5.4: Correlation media, political, and regulatory agendas

	Media agenda / Political agenda	Media agenda/ Policy agenda	Political agenda/ Policy agenda
Governance structure	.962**	.633**	.525*
Communication	.888**	.009	-.146
Research and advice (by regulator)	.736**	.285	.005
Benefits	.887**	-.193	-.242
Citizens' feelings	.914**	-.266	.240
Material damage	.846**	.067	-.268
Physical hazard	.658**	.128	-.313
Decision making	.945**	.250	-.025
Safety issue	.918**	.458*	.113
Total	.906**	.263	-.041

** $p<.01$; * $p<.05$

activity rather than the risk, followed by gas drilling as a *safety issue* and *material damage*. The media focus mainly on the concern that earthquakes as a consequence of gas drilling are a *safety issue* for Dutch citizen. *Safety issue* is the most important subtopic, followed by *decision making* and *physical hazard*. The media provide little information about *governance structures*, whereas this is a prominent subtopic in the parliamentary debates and SodM. The regulatory policy agenda provides hardly any information about *citizens' feelings*, whereas this subtopic plays a prominent role in media reports. Politicians refer relativity seldom to the physical events or research that should be carried out.

5.4.3. Interaction between the media, the political, and the regulatory agenda

Lastly, we studied how the subtopics on the three agendas interacted with one another. Table 5.4 shows the correlations between the nine subtopics on all three agendas over time. Interestingly, all nine subtopics correlated reasonably well for the media and political debates ($p<.01$). For the media and the supervisory agenda only the subtopics *governance structure* (.633, $p<.01$) and *safety issue* (.458, $p<.05$) correlated reasonably well. For the supervision and politics agenda, almost no

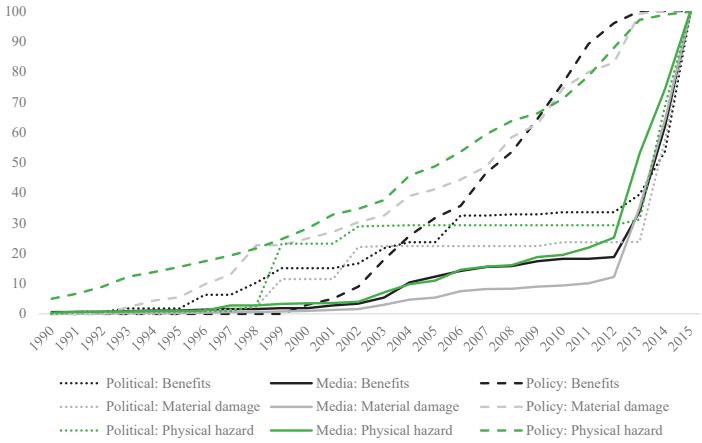


Figure 5.4: Cumulative cognitive risk aspects on media, politics, and regulatory policy agendas between 1990 and 2015

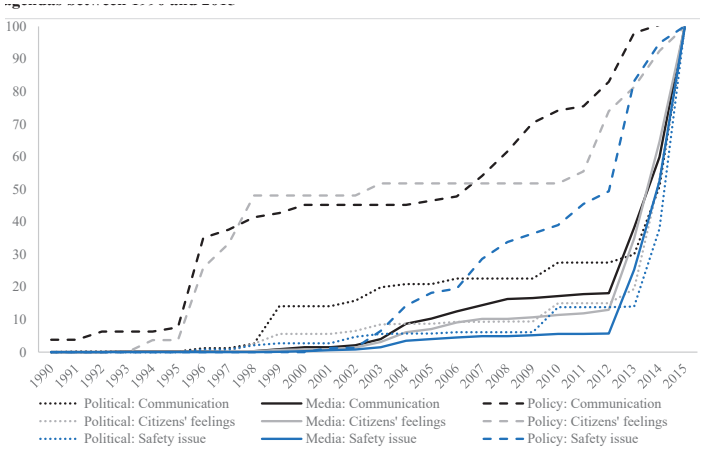


Figure 5.5: Cumulative emotion-loaded risk aspects on media, politics, and regulatory policy agendas between 1990 and 2015

correlation was observed, except for *governance structure* (.525, p<0.5).

We also studied the time dimensions in the development of the subtopics. To provide an overview of the attention on the three agendas over time, we bundled subtopics where the types of information could be linked to one another. *Benefits*, *material damage*, and *physical hazard* can be characterized as factual information and refer to the factual and ontological elements of the risk because these all link to

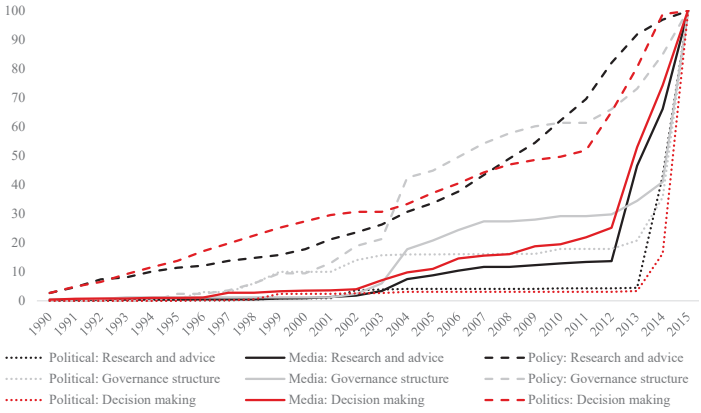


Figure 5.6: Cumulative managerial risk aspects on media, politics, and regulatory policy agendas between 1990 and 2015

factual information about the situation. *Citizens' feelings*, *lack of communication*, and *safety issue* can be characterized as more perception aspects of actual risk. The managerial aspects of the risk are *research and advice*, *governance structure*, and *decision making*, because they link to decision making and institutional structures.

We start with the topic group focusing on the factual subtopics, *benefits*, *material damage*, and *physical hazard*. *Benefits* of gas drilling were already discussed on the political agenda before 2000 (Figure 5.4). After 2000, *benefits* gained attention in regulatory policy documents. Media attention, apart from a brief interest around 2003 and 2004, followed regulatory policy and political attention at a low level and caught up after 2011. From 2011 onwards, attention on this subtopic increased in the media, whereas attention in the regulatory policy documents died off. Media and political attention did not seem to have an impact on regulatory policy documents. For *material damage*, political attention had already increased earlier in 1999 and 2002 without corresponding media attention. The regulatory policy documents revealed continuous attention on this subtopic over time. *Physical hazard* attracted a peak of political attention in the period 1998–2000, after the frequency and intensity of earthquakes began to increase; this was repeated to a lesser extent in 2002.

We continue with the dynamics in the use of emotion-loaded subtopics, *citizens' feelings*, *communication*, and *safety* (Figure 5.5). Interestingly, for the first, more perception-related subtopic – *citizens'*

Table 5.5: Codes' precision, recall, F1-Score, and St.dev. of F1-score of newspapers

Code of the subtopic	Average precision	Average recall	Average F1-score	St.dev. F1-score
Safety issue	0.848	0.724	0.781	0.033
Decision making	0.863	0.680	0.761	0.060
Physical hazard	0.865	0.788	0.824	0.023
Material damage	0.857	0.689	0.764	0.039
Citizens' feelings	0.837	0.628	0.718	0.065
Research and advice	0.868	0.816	0.841	0.053
Benefits	0.856	0.721	0.783	0.044
Communication	0.893	0.709	0.791	0.043
Governance structure	0.860	0.806	0.832	0.092

Table 5.6: Codes' precision, recall, F1-Score, and St.dev. of F1-score of political documents

Code of the subtopic	Average precision	Average recall	Average F1-score	St.dev. F1-score
Safety issue	0.780	0.707	0.742	0.119
Decision making	0.863	0.654	0.731	0.040
Physical hazard	0.695	0.516	0.592	0.091
Material damage	0.833	0.743	0.785	0.043
Citizens' feelings	0.674	0.315	0.742	0.119
Research and advice	0.862	0.820	0.840	0.053
Benefits	0.719	0.479	0.575	0.060
Communication	0.726	0.595	0.654	0.093
Governance structure	0.647	0.381	0.480	0.067

feelings – the data show that the supervision authority actually was the first to pay attention to this subtopic, although later on this decreased. Initially, media gave only limited attention to this subtopic, although there was a sudden rise in 2010. Thereafter, the subtopic was picked up (again) by media, followed by political debates. After 2012, political attention preceded media attention. The subtopic *communication* displays a steep increase in attention in regulatory documents in 1996, after which the subtopic died off until 2007–2008. Besides a short increase in political attention in 1999, the real increase in this subtopic occurred again after 2012, when media and political attention

fed each other. *Safety issue* was almost neglected on media's and politicians' agendas until 2012, despite the fact that attention was paid to gas drilling as a safety topic in the regulatory policy documents since 2002. In 2012, we see a disjointed increase in attention on media and politics agendas. Attention on safety further increased on the two other agendas, whereas the attention on risk as a safety topic in supervisory documents decreased after 2013.

We continue with the managerial subtopics, *decision making*, *research and advice*, and *governance structure*. *Decision making*, which displays almost the same pattern on all agendas, has the best correlation of all subtopics. Very little attention was paid to this subtopic until 2012 – only a little in regulatory policy (Figure 5.6). *Research and advice* displays similarities with the previous subtopic, i.e. until 2012 the supervision authority paid the most attention to it. However, political attention occurred only after the media had picked it up. *Governance structure* received attention in regulatory policy documents and political debates around 2004, but was almost neglected by the media.

5.4.4. SML reliability

We measured the accuracy of the SML method by comparing it against the human-coding outcomes. The SML media reliability scores are presented in Table 5.5 and the political reliability scores in Table 5.6. For all subtopics, recall and precision are better for the larger dataset of newspapers compared to the parliamentary dataset. Prominent subtopics such as *safety issue* show high recall and precision in both datasets. *Governance structure* on the other hand shows some precision in the political document analysis, but has a low recall.

5.5. Conclusions and reflections

In this article, we studied the interactions of attention towards a public risk on three agendas: the media, the political, and the regulatory. Our aim was to analyse this relation longitudinally and answer three research questions: 1. How does the prominence (frequency and strength) of the risk become manifest on the media agenda? 2. How do the media, political, and regulatory policy agendas address the risks and benefits of gas drilling? 3. How do the three agendas interact with one another over time?

We took gas drilling as our case to study a risk issue that remained uncontroversial on the media and the political agenda for a long time and then suddenly changed, resulting in an institutional crisis. We adopted a combination of various perspectives that contribute to one another – risk analysis (especially SARF), media and mediatization literature, and agenda theory – to direct our research. Such research requires a lot of data, and therefore we used a relatively new method – supervised machine learning – to generate a larger dataset. We first discuss the main conclusions and their theoretical implications. Then, we reflect on the method and limitations of the research.

5.5.1. Prominence is not the key

In line with previous studies (Renn, 1991), we find that the emergence of the risk on its own did not stimulate media attention. More and stronger earthquakes induced by gas drilling were hardly covered in the media for two decades. The manmade nature of the risk, which cannot be controlled by citizens and which increases inequity, was not enough to create news value. This was unexpected and may be a consequence of the longevity of the emerging risk. However, our Expectation 4 drawn from SARF theory about high prominence in combination with a lack of news value is confirmed. Despite clear evidence that induced seismicity was a manmade risk, we see a clear attenuation of risk where the risk was given less attention than justified. It is only after 2012 that strong media attention and political attention can be observed. SodM annual reports as well as licence renewals for the Dutch Petroleum Company to drill gas were the main items for decades. Gas drilling was a low-news-value technical subdomain (Shoemaker and Reese, 1996) regulated by specialists, resulting in only incremental changes in administrative policy. In that sense, our case fits Baumgartner and Jones' (2009) punctuated equilibrium theory, and the results support our Expectation 2. The media storm in 2012, which caused a disjointed change in political attention, is fully in line with this theory where pressure gradually builds up. Immediately after the 2012 tremor, SodM changed its reporting in the public sphere and advised taking not gas production but rather safety as the starting point for policy. Boon et al. (2019) showed in their study that independent and large agencies, such as SodM, are subject to both more positive and more negative media coverage because these agencies are identifiable, evaluable, and salient at the same time; this may influence the rapid media coverage. *Is this what you mean?* Thus, the risk event was

interpreted by the media as a safety threshold, based on SodM's new interpretation of risk. Expectations 1, 2, and 3 are therefore supported.

5.5.2. Differences between agendas

The three agendas show similarities in their use of content subtopics, although the extent to which these are applied differs. The regulatory authority focused mainly on factual information on the risk during the whole period, such as the prominence (*physical hazard*) of the event, and reported only minimally on *citizens' feelings*. This is consistent with Renn et al. (1992), Baumgartner and Jones (2009), and others who indicated that governmental bodies often share factual risk information.

At first glance, it looks like media focused mainly on reporting earthquakes as a (perceived) threat to human safety when all articles for the whole period of study are taken together. This is in line with previous research (and Expectation 3) indicating that media have a tendency to report on emotion-loaded subjects (Mazzoleni & Schulz, 1999; Bennett, 2009). A closer longitudinal analysis shows an overlap for two decades in media subtopics and subtopics addressed in parliamentary debates.

The dramatic change in issue attention in the media in 2012 and consecutive years can to a large extent be explained by the use of the subtopic *safety issue*. This subtopic underlies a value conflict between *citizens' safety* on the one hand and for example economic values on the other. The underlying cause of a critical subtopic is no surprise, as it is already the foundation of conflict expansion theory (Schattschneider, 1975), agenda setting (Cobb & Elder, 1983), and SARF (Kasperson et al. 1988). Lörcher and Neverla (2015) found that dramatic subtopics relating to human interest and conflict play a critical role in longitudinal framing studies.

5.5.3. How do the agendas interact?

We find a significant correlation between most subtopics addressed on the media agenda and the political agenda, indicating similar patterns in coverage for all subtopics over time. The SodM agenda is a bit different, and subtopics addressed hardly correlate with subtopics used in the media and the political debates when all reports are taken into account. Only the subtopic *safety issue* correlates well between the three agendas.

If we look at the patterns, we see that media and politics very much seem to influence each other and show a positive feedback and follow each other, whereas the regulatory agenda seems to follow its own

course. News value is the important trigger here to attract the attention of media and political actors (see Binder et al. 2015; Renn et al. 1992).

The news value in our study was not created by the earthquake itself, but by SSM, which started reframing the issue towards a safety problem. Because of this redefinition by the regulatory authority, the news value of the risk increased. We conclude that news value was critical for the amplification and rippling that occurred; this is congruent with prior research (Binder et al. 2015; Kepplinger & Habermeier, 1995; Renn et al. 1992). Conflict and human-interest-related issues became dominant on the media agenda followed by the political agenda. A growing controversy between benefit and risk advocates was visible after 2012.

Limitations and future research

Of course, this study has limitations. This case of the dynamics in the interaction and attention at subtopic level by media and politics is located in The Netherlands. The strong influence of media attention on political debates may, according to Vliegenthart et al. (2016), partly result from The Netherlands' multiparty democracy system. Such bias may be strong in this case, because over the period media attention expanded rapidly and a political election took place. Although not further studied, the parties' political campaigns were influenced by the gas drilling case.

The study focused on print news media. This obviously is a serious limitation, as other traditional media like radio and television play an important role in agenda setting. In addition, social media are not taken into account, although, in the first period of the study, this limitation was probably unimportant. In the period after 2000 and particularly after 2012, social media may have seriously influenced political debates and may also have stimulated media to start reporting about safety and threat. An issue subtopic that was not extracted by SML from newspapers and political debates was *health*. Although this was not further investigated, we have the impression that this subtopic, and particularly *mental health*, might be important among citizens and on social media.

Regulatory agenda as outlier: a new finding

We believe, however, that this case study has contributed to elucidating the complex and relatively unstructured phenomenon of media-destabilized risk policies. In accordance with Howarth (2013), we

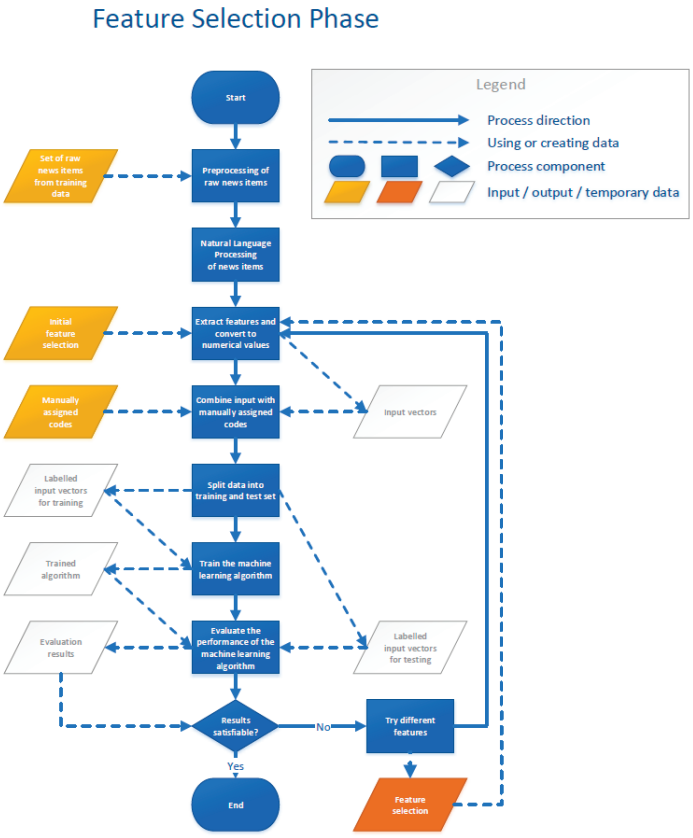


Figure A5.1: The machine leaning process – continued on the next page.

underscore the need for more empirical case studies on the interaction between risk, media, and policy, focusing on different risk policies and within different countries and contexts. In general, this study reconfirms some assumptions from theory and research but also finds some interesting new insights. In line with earlier theory and research, we find strong positive feedback between media and political attention; but, contrary to most theoretical assumptions, we do not find a strong correlation between political and media attention on the one hand and regulatory attention on the other hand – this while most theories (see Cobb & Elder, 1984, but also Baumgartner & Jones, 2009) assume that media attention also influences the policy agenda (and implementation). Although media attention certainly helps to build up the tension for the political agenda (and for making decisions that

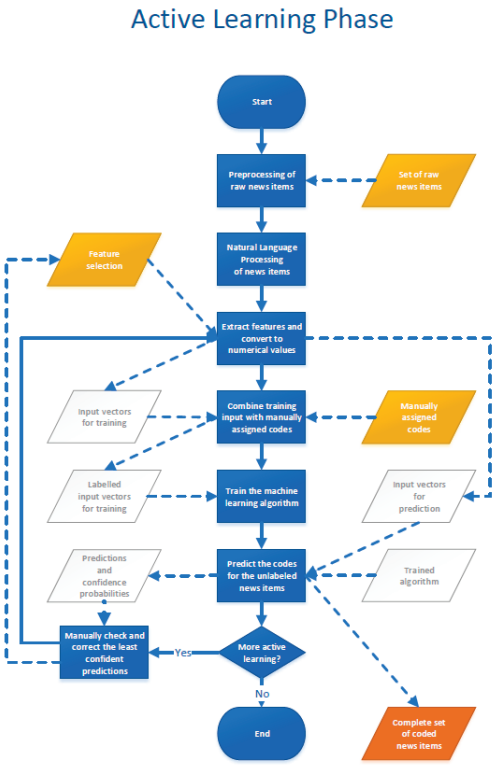
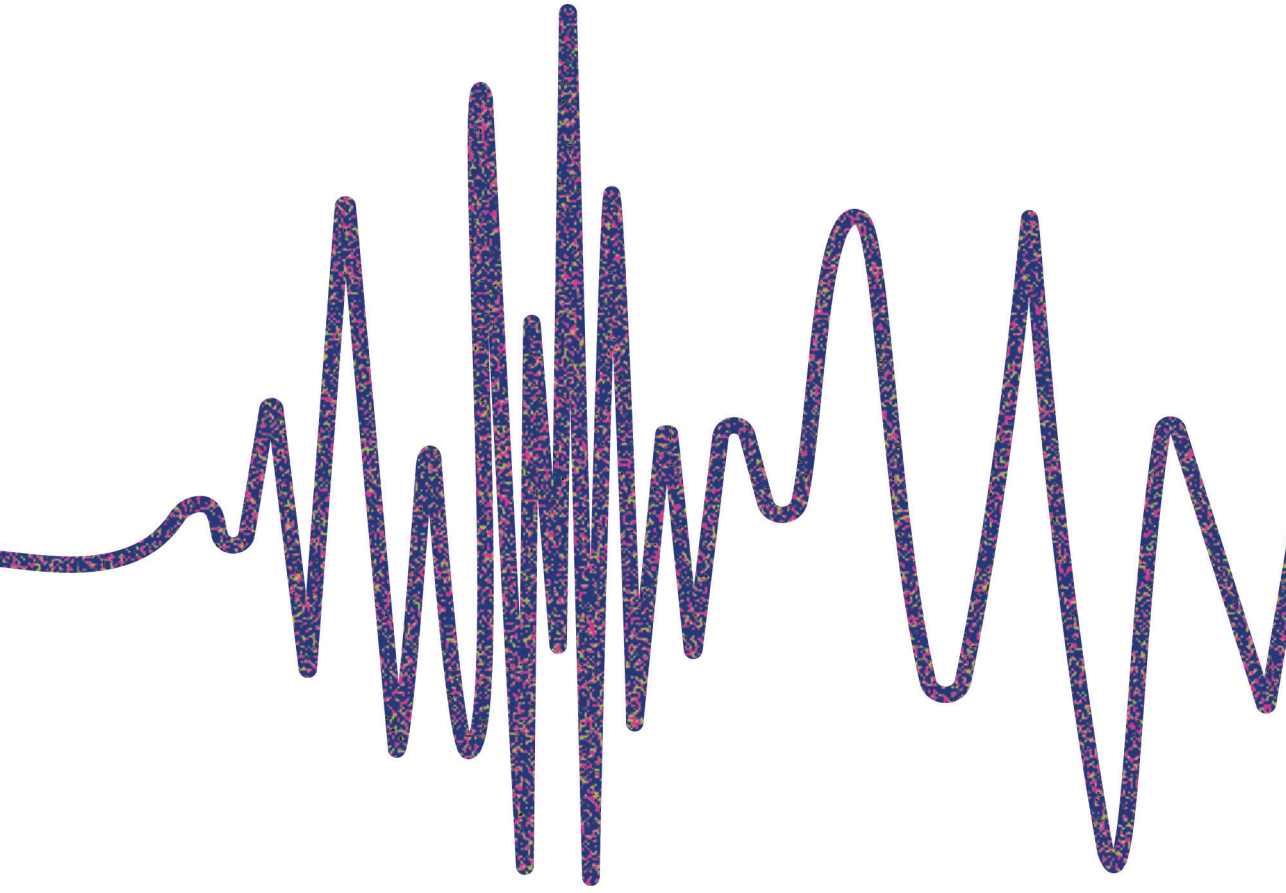


Figure A5.1: The machine leaning process, continued.

change the course of policies), the regulatory agenda seems to have its own course and usually spots important issues before the media and politicians do. We even have indications that important documents in the regulatory arena have a greater impact on media and political attention than vice versa. We may have to adapt somewhat our ideas on agenda building and media attention.



Chapter Six: The Roles of News Media as Democratic Fora, Agenda Setters, and Strategic Instruments in Risk Governance

Abstract

This study analyses news media's role in governmental decision making processes related to a gradually intensifying series of earthquakes resulting from gas drilling in The Netherlands and to catastrophic natural earthquakes in Italy. According to the risk governance actors interviewed in both cases, media play three roles, as: democratic fora, agenda setters, and strategic instruments. Media attention on risk can create ripple effects in governmental decision making processes. However, media attention tends to be risk-event driven and focuses on direct newsworthy consequences of events. For non-event risks, or when newsworthiness after a risk event fades, the media's agenda setting and democratic fora roles are limited. This contributes to risk attenuation in society, potentially resulting in limited risk prevention and preparedness. Governmental actors report difficulties in using news media for strategic communication to facilitate risk governance because of media's tendency towards sensationalism. Our research suggests that, in the governance of earthquake-risk news, media logic overrules other institutional logics only for a short while and not in the long run when the three roles of media do not reinforce one another.

This is an adapted version of the published article:
Opperhuizen, A. E., Pagiotti, S., & Eshuis, J. (2020). The roles of news media as democratic fora, agenda setters, and strategic instruments in risk governance: A double international case study on earthquake risk. *Journal of Risk Research*, 1-15.

6.1. Introduction

News media such as newspapers, television, radio, and online sources play an important role in risk governance processes because they provide society with risk information about the causes and effects of risk events. Many risk researchers have studied the role of media in the social construction of risk (e.g. Gamson & Modigliani, 1989). In addition, scholars have focused on media's prominent role in shaping public risk concerns, perceptions, and attitudes and in amplifying or attenuating risk signals by selecting and framing messages (e.g. Kasperson et al., 1988; Löfstedt & Renn, 1997; Bakir, 2010). Less attention has been paid to media's role in risk governance processes conducted by civil servants and public bureaucracies in multi-stakeholder networks, although media in democratic countries usually report on public actors' positions and actions in governance processes, often publicly questioning them (Hood, 2010). When media report the responses and repercussions in the aftermath of a risk event, they emphasize certain aspects of risks and often focus on governance actors' responsibilities and not on factual information about the risk (Renn, 2008). As Howarth (2013) states, capturing the dynamics between political and media actors is '*the weakest link*' in research about the social amplification of risk. In this paper, the term media refers to *news media*, which include print media (newspapers and magazines), broadcast news (radio and television), and digital media (online, blogs, twitter, and so forth).

The research question in this study is: *What is the news media's role in the risk governance decision making process regarding earthquake risks?* In the current study, the social amplification of risk framework (SARF) (Kasperson et al., 1988) serves as a backbone for further investigation of roles that news media play in risk amplification processes in society and in influencing risk governance of recurring earthquakes. We build on media's three roles (democratic fora, agenda setters, and strategic instruments) identified by Korthagen (2015) in relation to governance processes. Empirically, the study draws on two cases: 1) a gradually emerging earthquake risk induced by human activities (gas drilling) in The Netherlands and 2) tectonic movements underground in Italy that caused strong, recurring disruptive earthquakes in the Italian Norcia region.

6.2. Theoretical framework

6.2.1. Risk governance and the social amplification of risk

Risk issues are often governed through interactive and complex decision making processes (Renn, 2008). According to Klinke and Renn (2019, p. 2), risk governance '*marks out institutional structures and socio-political processes that guide and restrain collective activities …*' aiming to prevent and reduce negative impacts. Risk, by definition, is not only about objectivity but also about subjectivity. For example, public risk perception and acceptance of earthquake risks were shown to be more negative for human-induced earthquakes than for natural earthquakes (McComas et al., 2016). Risk governance networks therefore have to deal with perceived risk and responses by actors in society that may deviate from expert risk assessments (Wardman & Löfstedt, 2018).

SARF provides a broad conceptual framework for understanding the dynamic character of societal risk responses (Kasperson et al., 1988). Risk amplification entails processes that both intensify and weaken risk attitudes and responses in society (Kasperson et al., 1988; Rip, 1988; Fjaeran & Aven, 2019). In the first stage of SARF, risk events, situations, or objects may emerge and obtain *signal value*, meaning that an issue becomes more or less perceived and attributed as a risk for society. A flow of messages can arise and images may spread in media, whereby risk as a social construct accrues further salience and significance. This can stimulate concerns in the public sphere and in the economic or political arena, and can affect institutional processes and structures in the governance network. These *ripple effects* go beyond the direct harm of the risk event and include, for example, political debates, governmental decisions, and changing economic activities (Kasperson et al., 1988). This also entails responses and repercussions about failures to prepare for events predicted by scientific risk assessors (Poumadère et al., 2005). Burns et al. (1993) argued that public responses in various cases appear to be determined by perceptions that risks are caused by managerial incompetence.

Signals of substantial risks for society are not always intensified. They can also be weakened, a process called attenuation. Attenuation can lead to 'doing nothing' in risk governance (Fjaeran & Aven, 2019).

6.2.2. Three news media roles in risk governance processes

News media play an important role in the deliberation and social construction of risk, and therefore influence citizens' risk perception

and concerns (Renn, 2008; Walker et al., 2010; Bakir, 2010). The three roles – democratic fora, agenda setters, and strategic instruments – identified by Korthagen (2015) for media in governance processes are distinguished analytically, but interact and may reinforce one another in practice.

Media as democratic fora

Media provide a platform for informing citizens (Bakir, 2010), disclosing information about a risk event when personal experience is lacking (McCombs, 2004), and enabling public discussion (Schudson, 2008). Media's watchdog function enables citizens to monitor governmental performance (Aalberg & Curran, 2012) and to hold government accountable for its risk governance (Iyengar & Simon, 1993). Critical media can be beneficial when their attention helps governance networks to function better (Norris, 2014).

Media as agenda setters

Risk issues that attract a lot of attention become a prominent concern for society (McCombs, 2004), and this focus influences public opinion (Scheufele & Tewksbury, 2007). By selecting and framing issues that are relevant (for stakeholders) in society, media have an agenda-building role (Driedger, 2008). Media thus can put risk issues on decision makers' agendas (Elder & Cobb, 1983; Baumgartner & Jones, 2009; Van Aelst & Walgrave, 2011).

Media as instruments for strategic communication

News media have a large reach in society and can be used by actors within stakeholders to communicate their messages. Kepplinger (2007) showed that media reports influence actors' awareness, cognitions, and emotions. Media can also be used to stimulate or discourage individual and group risk behaviour (Kasperson et al., 1988; Bakir, 2010).

Media logic, mediatization, and risk governance

In all three roles, news media operate through a specific *media logic*, translating and transforming information in specific ways. Media logic implies that reporting tends to focus on negative news, human interest stories, and drama (sensation) (Bennett, 2009), thus shaping risk information. Opperhuizen, Schouten, and Klijn (2019); (see Chapter three this dissertation) showed that media logic shapes Dutch news media reports on gas drilling-induced earthquakes. Kepplinger (2007)

and Vasterman (2018) argued that news media may become very influential in the social construction of risk, particularly when an issue causes a media hype. Kepplinger (2007) argued that media logic may cause journalists to become part of the risk issue themselves and create reality on their own. The leading perceptions shaped by media, including realities created by journalists, are not without consequences and influence decision making processes directly (Wardman & Löfstedt, 2018). Scholars even speak of the mediatization of politics (Mazzoleni & Schulz, 1999; Strömbäck & Esser, 2009; Hjarvard, 2013).

Thus, ripple effects generated by media reports can influence risk governance processes (Renn, 2008). Versluis et al. (2010) contended that attenuation of risk in society may lead to the neglect of risk governance preparedness in the long run. Poumadère and Mays (2003) asserted that, after the risk perception about heatwaves changed and initiated the social amplification of the risk, risk governance measures were rapidly taken. However, as time went on, media attention faded and planned risk preparedness activities were cancelled. Fjaeran and Aven (2019) argued that, for non-event risks, the *modus operandi* is often societal and managerial non-response. In addition, risk managers can play a substantial role in the attenuation of risk by not responding to risk signals from experts (Poumadère et al., 2005). Although mediatized amplification and attenuation of risk have important consequences for risk governance networks, this issue has not yet been systematically studied in the light of SARF.

SARF has been criticized for its lack of precision and theoretical foundation, particularly regarding the creation of ripple effects, or the lack of them (Rip, 1988). According to Rip (1988), it is unclear what creates the ripples; is it only the event itself, such as an earthquake, or also the perception of the risk? Rayner (1988) also criticized SARF, arguing that societal risks can be mentally constructed without events. Busby and Onggo (2013) contended that subjectivity is critical for the impact that risk signals have on society. In the study at hand, both the risk (particularly the adverse consequences of events) and the risk signals (influencing perceptions and responses) can be amplified or attenuated, for instance after reframing or novel interpretation of available information. News media play an important role either by initiating social amplification processes or by amplifying ripples previously created by risk events or perceived hazards.

6.3. Methodology

6.3.1. Case selection

This research involves a double, international case study of earthquake risks in The Netherlands and Italy, but we do not investigate national differences between Italy and The Netherlands.

The earthquake risk in The Netherlands exemplifies a gradually evolving, human-induced environmental risk. Prior to the start of gas extraction in 1963, the area was aseismic, but decades of gas extraction from the early 1990s onwards resulted in a slight but gradually increasing frequency of earthquakes of higher magnitudes (Vlek, 2018). Until 2012 however, the earthquakes were not a strongly debated risk issue in the news media (Opperhuizen, Schouten, & Klijn, 2019). This changed when an earthquake (M=3.6) struck the region that caused much more damage to houses than previously experienced. Earthquake risk then became a prominent issue in the news media and on the policy agenda (Opperhuizen, Klijn, & Schouten, 2019). This Dutch case was selected because (a) it exemplifies the risk of earthquakes as a direct consequence of human action, (b) the earthquake risk arises more from the high frequency and less from the (disruptive) magnitude of particular earthquakes, and c) news media played an important role in raising social and political awareness of the risk (Van der Voort & Vanclay, 2015).

The second case is located in an Italian region with a long history of seismic activity. In 2016, strong earthquakes hit the Umbria, Lazio, Abruzzo, and Marche regions (average M=6.2); and in 2017 another series of earthquakes (average M=5.3) occurred. The media reported elaborately on the earthquakes but were accused of misleading the public with incomplete, propagandistic, and contradictory information, causing fatal consequences (Bock, 2017). The broad media coverage also negatively influenced an important economic sector: tourism. This Italian case was selected for three main reasons: (a) it exemplifies natural earthquake risks and thus contrasts with the Dutch human-induced earthquake risks, (b) the earthquake risk arises more from the disruptive magnitude and less from the frequency of earthquakes, and c) news media played a substantive role in raising risk awareness.

6.3.2. Interviews

Thirty-three semi-structured interviews were conducted (18 in The Netherlands and 15 in Italy) with representatives of the most important national and local actors involved in the risk governance network at

Table 6.1: Codes for analysing media roles

Concept	Codes for media role
Democratic fora	Actors publicly discuss risk issues in media and obtain their democratic information from media
	Citizens' ability to 'check' risk governance processes and their performance through media
	Misbehaviour or unfavourable decisions are translated into media attention. The media function as watchdog
	Critical media attention helps the governance network to function better
Agenda setter	Media put risk issues on the decision makers' agenda. Media select and frame risk issues that are relevant (for groups) in society
	The way media select and frame a risk issue influences perception and acceptance of the risk
	Risk issues that attract a lot of attention become a prominent concern for society
	A shift in media attention (amount and content) can disrupt the decision making process
Strategic instrument	Media are used to transmit risk information between the risk governance network and others in society
	Actors within the risk governance network use media as transmitting station for information
	Media messages impact decisions
	Media messages are used as instruments to influence individual risk behaviour

various government levels, multiple local citizen groups, and experts. Appendix 6.A provides an overview of the organizations involved. The respondent sample reflects the stakeholders' various interests in the governance network regarding risk governance and media coverage, thus preventing a one-sided view of the cases. There were no interviews with journalists however, or other actors outside the (broadly demarcated) governance network. Thus, this paper analyses the role of the media on the basis of sources external to the media themselves.

The semi-structured interviews were tailored to each interviewee's role in the risk governance process. Confidentiality was guaranteed to encourage respondents to discuss sensitive topics. A codebook based on the theoretical roles of news media in governance processes was used for the coding process (see Table 6.1).

6.4. Empirical results

6.4.1. Democratic fora in the Dutch case

In the Dutch case, the respondents agreed that, in general, the media serve as democratic fora, acknowledging that citizens' voices are represented. Local groups, however, were critical of how the media chose their stories and images. Others argued that their voices were less heard than other citizens' voices and that different sides of the story were not sufficiently reflected. Hence, they also reflected critically on the democratic fora role played by the media. Actors tried to share facts and explanations with the media, but these were often ignored; in their view, media prefer sensational news. According to several interviewees, some (especially local) media tended to focus on citizens' feelings, adopting an activist attitude in messages:

> *…by all means, the tone of media shows what society thinks, expects, and wants to hear in this area.*

It is difficult for actors to publicly discuss risk issues with citizens via the media. Interviewees find it hard to enter the public debate because it is so complex. Consequently, they feel unheard by the governance network and are dissatisfied. Participation in democratic fora is tough for some actors because:

> *…It is operating in a minefield, with very complicated matters to explain simply.*

According to a majority of respondents, the media should be more critical and more informative because that is essential for the proper functioning of society. In their view, media focus strongly on heat-of-the-moment issues instead of on proper research journalism. Respondents report a situation whereby risk issues regarding earthquakes seem to be not newsworthy enough. The lack of newsworthiness is seen as dangerous, because the media's control function is important for society as well as for the risk governance network.

> *…they look over your shoulder, and we have to explain or disprove questions correctly*.

6.4.2. Democratic fora in the Italian case

In the Italian case also, the media as democratic fora are both acknowledged and criticized by respondents. The media function well by quickly informing relevant parties about public questions, needs, and issues voiced by citizens.

> *…we [local citizens] knew what the problems were and they [the media] were able to bring them to the attention of relevant people.*

Respondents generally see the dialogue between citizens and media as beneficial for general discussions, sometimes leading to improvements in the decision making process. Media attention also helps to improve actors' own decisions and actions. Because an earthquake is not an ordinary situation and various solutions must be found for a complex set of problems caused by the hazardous event, a good evaluation by the media helps to improve decision making and detect possible flaws, according to interviewees.

Some actors mentioned that media help to keep a check on the risk governance process, enabling citizens to monitor policy decisions:

> *… Moreover, the press is also an instrument to draw attention to the area, so that the administration acts in the public interest without unjustified delays. What matters is being precise, pinpointing responsibilities, and asking those in charge to make better interventions.*

However, respondents formulated two main critiques: i) media do not persist in reporting in the long run: directly after an earthquake, there is plenty of media attention because of the dramatic nature of the event, but then the media fail to follow up on successive developments; ii) media show unrealistic images and stories, regularly quoting people with bizarre opinions. Multiple respondents argued that the incorrect information, *self-managed reality*, provided by media does more harm than good to citizens, because media often adopt a sentimental approach with superficial analysis of the problem definition. Consequently, the '*real problem is overlooked*'. The negative and complex spread of information makes it more difficult to improve risk governance decisions. A respondent from a citizens' organization said:

… Being destructive is very easy, whereas being constructive is very difficult. There are many problems, I am not denying it, but you also have to look for other stories, be proactive… what was missing was investigative journalism.

It was argued that the incorrect information and sensational messages provided by the media is harmful for the authorities and also affects communities negatively.

6.4.3. Agenda setting in the Dutch case

The media's role as agenda setter is acknowledged, but the respondents agreed that, in the earlier years of the earthquakes, media did not fulfil this role. For a long time, media did not take the risk of earthquakes seriously.

…In Groningen, there was a silent disaster.

According to several respondents, the enormous economic revenues from gas made it difficult to put the risks on the agenda. Local interest organizations tried to '*keep the fire heated*' by writing about certain aspects of the risk issue, but it was hard to get these messages across in the media, respondents stated. Agenda setting is only possible by highlighting stories that influence people's risk perceptions:

….it gives the feeling a disaster is increasing when everyone talks about it.

Respondents' opinions differ about media's influence on risk perception and acceptance. Some argued that media attention is positive because it puts social issues on the governance agenda. Others believed that the media do not create real awareness at societal level, because the distance between the risk and their audience remains large:

…Apparently, you have to experience it yourself to know what this risk is really about, so it is still a regional problem and not a national problem.

Only a negative and sensational story may break this frame according to some interviewees: '*this risk issue is not mediagenic enough*'. This

limits the media role as agenda setter for the national policy agenda, according to respondents.

Actors indicated that, when the media put the spotlight on earthquakes in 2013, the topic also appeared on the political agenda. It '*is a chicken and egg story*', and it remains unclear whether media attention or political debate came first, but they definitely reinforced each other. Media's focus on a certain issue indicates a socially sensitive issue, and politicians can hardly neglect it.

> *…media ask questions about the decision making process… When there is no media attention, a decision maker will analyse the situation quietly, but when the media address the issue, everybody directly wants to see a policy response.*

Increased media attention leads to simplistic calls for action, a respondent argued. Actors noted that the economic interest in gas supply was suddenly replaced on the governance network's agenda by the need for action. Multiple respondents asserted that politicians are sensitive to hypes, and one respondent underlined that this may even be dangerous: '*it has all become short-sighted, this is a pity or it is even a dangerous development*'. Some respondents indicated that too much media attention leads to overreactions, with negative results when they are not in line with carefully defined priorities:

> *…It is a toxic mixture of politics and media that creates a certain pressure that is so big that it is almost impossible to cope with.*

All respondents agreed that the media affect the political agenda directly, but they doubted the impact in the long run.

6.4.4. Agenda setting in the Italian case

Actors noted that the way in which media informed and framed information played a crucial role in the Italian governance network during the emergency phase. However, media reporting was confusing also. It informed actors about the severity of the situation and underlined that the emergency required serious attention.

> *… This showed that media only come after the first phases of an emergency, and it's difficult to rely on news.*

Governance network actors agreed that, after the emergency phase, the media had an agenda setting role, showing major concern towards society and influencing the activities of several actors within the network. '*The political agenda was directly affected, which unfortunately did not translate into many immediate and concrete actions*.' Actors saw media as a necessary institution for regional visibility, indicating that many representatives of Italian institutions visited the area during the emergency phase. However, this visibility was temporary: '*If they stop talking about it, the State may lose interest in solving the current problems, which have become even worse*.' Media and political attention decreased while citizens continued to face difficulties. The falloff in attention was unfortunate, because many more things remained to be done, and many people still faced difficulties years later.

Additionally, according to the interviewees, media reports were sensational, as sometimes they gave the idea that the entire province was permanently subject to earthquake shocks. The number of reports and the framing repulsed citizens and tourists, according to interviewees, thereby hindering economic recovery.

Respondents indicated various expectations of the media as agenda setters. First, they indicated that there should be more sensitivity and precision in media reports, to avoid indirect damage. Second, a more positive image of the region should be projected. In addition, several interviewees said that the media do not highlight the positive attributes of the region. Positive news would create more trust in the region, e.g. more jobs would be created. Another respondent adopted a positive tone regarding media as agenda setters:

> *…we wouldn't be able to solve the issue without the help of newspapers or television. We really were able to speak at national level about what was a major problem for us at that moment. Media sometimes are necessary to raise awareness about critical issues of the earthquake.*

6.4.5. Strategic instrument in the Dutch case

Respondents reported that they try to use media as strategic instruments to tell their own story to serve their own interest. However, the reasons for doing so differed between actors. National and local governments employed media to announce decisions, arguing that they use the media to be transparent. At the same time, they acknowledged the difficulty of communicating about decisions in an easy and

understandable way. Citizens' groups and local authorities employed the media mainly to explain what citizens should do in specific situations, for example by providing information about the situation and communicating action plans to stimulate individual risk reduction behaviour. Besides the positive aspects of transparency, there are also doubts about transparency and whether or not it becomes the main focus of the network, i.e. causing goal displacement.

The media also functioned as strategic instruments for actors who wanted to communicate with the public, independent of other parties in the governance network. NAM, Safety Region, and KNMI argued that their independent role is extremely important and therefore they wanted independent communication messages. They were afraid that, if they sent a message jointly with another actor in the network, trust in their independence would be affected.

> *…you have to be very clear about what you are doing to ensure that you are not equated with other actors within the network. The way we communicate and intensify our communication, we show people that we work in a transparent way and do not have a hidden agenda.*

Other actors argued that the governance network should think collectively about when, how, and by whom a message is spread, bearing in mind that everybody needs their 'success' and '*you have to grant one another something*'. In their view, the governance network needs to make a plan and communicate strategically in a joint manner. Having one collective communication strategy is challenging according to the respondents however, because it conflicts with network actors' individual aims and interests.

Multiple actors mentioned that they change their strategy regarding media use over time. For example, the Ministry changed its strategy to show more commitment. This is a change from a decide-announce-defend strategy to a more interactive strategy with two-way communication:

> *…We are a techno-scientific department, turned inwards. Used to taking a decision with a group of people together with politicians and then executing the decision to make it known outside. It was new to talk about decisions with the environment. In the beginning, the department found it first surprising that the rest of the world*

did not understand what brilliant, well-balanced decisions were taken here.

The Ministry communicated publicly that there had been a governance failure, thus acknowledging what citizen groups had long been arguing. However, showing commitment through the media was not enough for local authorities and citizens' groups. They argued that showing commitment was nice, but they judged the Ministry on its actions in the decision making process. This illustrates how strategic media communication may not be sufficient to gain support if it is not backed up by concrete action. Some actors argued that long and consistent critical deliberation in the media affects decision making processes. For example, they reported that, after severe criticism in the press, the gas industry (NAM) was removed from damage-compensation claim procedures.

6.4.6. Strategic instrument in the Italian case

In Italy, media were used as strategic instruments for different reasons. First, media were used by authorities to collect and streamline the diffuse information that emerged during the catastrophic earthquakes and directly afterwards. This led to a fast exchange of information but also a diffuse information flow. Second, media were strategically used to highlight the need for resources (financial) in the area. However, in asking for donations, the authorities found it difficult to project a balanced picture in the media:

> *… We wanted to highlight that an earthquake had occurred and ask for help to show the most dramatic moments and difficulties, where people were frightened, the people complained about this. So, if we ask for help, reality must be shown as well.*

Third, in the period after receiving donations and the reconstructing phase, the media were used to communicate to the donors the measures taken by the municipality: '*we were able to show the whole world what we were doing*'. Thus, media facilitated transparency in the decision making process. In this case also, the negative side effect of transparency was mentioned: transparency can lead citizens to become critical of officialdom.

Further, media were strategically used to promote the region after the earthquakes to minimize indirect effects, like the decrease in tourism.

Many respondents mentioned that using (social) media to show the damage caused by an earthquake created a negative impression of the region. Therefore, they used media for promotion and became extremely aware of the content used. For example, the word 'safety' was not mentioned because it emphasizes the disaster instead of promoting the region.

6.5. Discussion

The results show that news media (print, broadcast, and online) in The Netherlands and Italy play roles as democratic fora, agenda setters, and strategic instruments in earthquake risk governance processes, although differences exist between the cases (see Tables 6.2, 6.3, and 6.4).

Table 6.2: Comparison earthquake risks and media's democratic fora role

Democratic fora	**Dutch case; gradually emerging earthquake risk induced by human activities**	**Italian case; disruptive earthquake risk caused by natural processes**
	Manifestations: • Citizens' voices are represented • Critical reflection on decision making facilitated after serious risk event • Local newspapers give space for critical essays on risk governance	*Manifestations:* • Citizens can check risk governance process because media place spotlight on reconstruction process • Reports by media facilitate actors' own decision making and actions
	Limitations: • Dissatisfaction about media focus, based on their own values and logic • Media logic often overrides factual accounts, causing: - Complexity of the policy issue, making it hard for citizens to enter the media agenda - Distrust in network governance, affecting public discussion	*Limitations:* • Watchdog function and transparency only directly after a physical risk event and not in the long term, with limited opportunities for social deliberation • Sensational framing focuses on citizens' negative stories, leading to unrealistic images and stories with biased problem definitions

Table 6.3: Comparison earthquake events and media's agenda setter role

Agenda setter	Dutch case; gradually emerging earthquake risk induced by human activities	Italian case; disruptive earthquake risk caused by natural processes
	Manifestation: Media enhance policy attention and influence the political agenda for a short period	*Manifestation:* Information provided about emergency phase, thus helping determine policy priorities Local visibility generated for problem and solutions stimulated (e.g. financial support)
	Limitations: No influence on agenda setting before serious earthquakes happen Agenda setting often results in short political (over) reaction, rarely in direct management decisions Agenda setting leads to simplification and short-sighted views and stimulates goal displacement Weak agenda setting effects at national level; the issue remains a local problem	*Limitations* Incorrect information by media results in errors on national and local governance actors' agenda Limited effects in terms of concrete reconstruction actions Visibility is used for politicians' own goals, i.e. political promotion Agenda setting is prominent in emergency phase Sensationalism and negative images cause negative effects on risk perception and regional tourism economy

The interviews show that, in both cases, media play an important role as democratic fora in the earthquake risk governance process by representing citizens' voices, thus enabling citizens to raise certain risk issues. Media also transmit and amplify risk information and stories, for example from a local to a national scope. This is consistent with previous research (McCombs, 2004; Schudson, 2008). However, one major problem that Italian and Dutch interviewees reported is that media are little interested in factual information, as also reported by Gearhart, Adegbola, and Huemmer (2019). Therefore, actors face difficulties entering the media and contributing to in-depth democratic deliberations with factual risk information.

In the Italian case, media reports in the emergency phase influenced risk perceptions and were used by actors within the network to determine the size of the disaster. The '*brute reality of the physical consequences*' (Busby & Duckett, 2012, p. 1066) was the dominant

Table 6.4: Comparison earthquake events and media's strategic instrument role

Strategic instrument	Dutch case; gradually emerging earthquake risk induced by human activities	Italian case; disruptive earthquake risk caused by natural processes
	Manifestation: Promotion of actors' own values and interests Used for transparency about decision making process Used to explain decisions to the broader public Help in the stimulation of individual risk behaviour Used to clarify actors' roles Used to show commitment from the network towards citizens	*Manifestation:* Used to share knowledge Used to influence resource allocation Used for transparency about the decision making process Help in promoting the region
	Limitations: Simple transmission of messages is difficult Sensationalism is required to attract media attention Goal displacement can occur as a consequence of the call for more transparency All the actors have their own media strategy, making a collective communication strategy challenging	*Limitations:* Focus on negative stories makes it hard to report positive and nuanced stories

media interpretation of reality in the short run. Media served mainly as a source of information for citizens about adverse social, economic, and cultural consequences. The agenda setting role seems marginal in the long run, and media appear less a forum for societal debate about interests, probably because the disruptive impact of the earthquakes left little room for other foci.

Gas drilling in The Netherlands created a long series of mild tremors (mainly magnitudes less than 3) that were often not noticed by citizens. The Dutch earthquake risk shows similarities with what Fjaeran and Aven (2019) classify as non-event risks, because the risk can be referred to as 'risk and uncertainty source', which results in no risk management response in the political arena, as was observed for decades. In the absence of a major event, media did not create ripple effects for long periods of time, and risks were actually attenuated by the news media.

Similar to catastrophic events in the Italian case, the democratic fora role is limited as the newsworthiness of non-event risk is low. However, particularly after 2013, media attention focused on earthquakes as an issue of social interest and conflicts. Actors used media's democratic fora role strategically to promote their own values and interests, and to explain and defend their opinions, responsibilities, and interests. Conflicting interests create discussion and ambiguity about possible mistakes and misbehaviour, which are important for social amplification processes according to Poumadère et al. (2003).

Overall, the cases suggest that the watchdog function in its own right hardly affects risk management decisions in the long run. The role of media in earthquake preparedness preceding hazardous events especially appears to be low, even when catastrophic events like the Italian earthquakes can be predicted and expected. This finding amends and specifies theory arguing that media generally function as a watchdog (Iyengar & Simon, 1993; Aalberg & Curran, 2012).

The limited role of media as democratic fora can be explained both by the complex nature of earthquake risk governance and by the logic of contemporary media. Firstly, earthquake risk and its governance are so complex that it is difficult for media to cover techno-scientific elements and make the issue salient for citizens to enter the public discussion. This easily leads to oversimplification by media and hampers social groups that try to counter unfavourable decisions or wrongdoing. Secondly, media logic narrows the focus to newsworthy aspects of risk, thus amplifying sensational, dramatic, and negative aspects and attenuating others (Altheide & Snow, 1979; Binder et al., 2015). Particularly media's sensation and drama focus, the negative framing of the societal consequences of earthquakes, and the mediatization elements were generally disliked and perceived as counterproductive by network actors. They complained that the media are not seriously interested in facts and develop a *self-created reality*. This is in line with previous studies by Kepplinger and Habermeier (1995) and Vasterman (2018). The consequence, according to network actors, is that the power to improve decision making in the risk governance network is undermined. The media's framing and logic may cause the actual risk to be overlooked and generate negative ripple effects with adverse consequences for risk governance, as Rip (1988) already noted.

Regarding the agenda setting function, the findings indicate that media in both cases do set the agenda in the short run, but not necessarily in the long run, because media attention tends to fade after some time.

Consistent with our results, Kahlor et al. (2019) showed that, in the USA, media reporting about the risk of earthquakes related to gas and oil fracking was limited and faded rapidly after events. According to the risk governance network actors in our cases, the political arena was particularly sensitive to media hype, as also reported by Vasterman (2018). The short duration of media attention makes it possible for governance network actors to 'ignore' the media attention after a short period and return to business as usual, without changing their risk governance processes. This is an example of 'doing nothing' in risk governance (Fjaeran & Aven, 2019; Poumadère & Mays, 2003). Further, Versluis et al. (2010) stated that attenuation of risk in society may diminish risk preparedness and that signals for the long run may be neglected.

The multiplicity of opinions about the democratic fora role, in combination with the lack of interest in factual information, seriously hindered network actors' use of media's strategic role. As various actors stated, they were not successful in developing coherent strategies to use the media to support (collective) decision making and activities to deal with the risk events – despite some network actors indicating that they individually changed their media strategy in an attempt to make better use of media. In the Italian case, strategic use of media was successful in drawing attention to the financial problems and generating support and donations for recovery. However, the Italian media's strategic role in the long term was limited, and the focus on negative stories made it difficult for the risk governance network to expose the public to positive stories about reconstruction and social resilience. This secondary ripple may have had negative consequences for regional reconstruction, for instance through the negative impact on tourism.

Theoretically, the democratic fora and strategic roles of the media are not independent of each other. For example, the strategic role can be used to influence public discussions. Thus, both roles can provide a foundation for agenda setting in the long run. Amplification and prolongation of messages about the risk as a social construct and managerial competence may even affect processes and structures of institutions in the risk governance network. This aligns with the notion that ripples reflect complex patterns of selective attenuation and amplification (e.g. Kasperson et al., 1988). However, in our cases, actors were not very successful in using the media strategically to influence the political agenda in the long run beyond clear risk events.

Dutch media seemed to be interested mainly in social elements of the earthquake risk, whereas the risk governance experts were more

interested in the technical or factual elements. This is consistent with existing literature showing that media often report on items relating to people's risk perception and attitudes, for example reports mention anger and blame, compassion, heroism, and anxiety (Dunwoody & Neuwirth, 1991). However, Dutch governance network actors persisted in using media's democratic fora role strategically, thereby ultimately exerting pressure on the Dutch political agenda. This did not result in major policy changes in the time period studied in this paper (2017–2018). However, in 2019, the Dutch government changed its gas drilling policies, and, although we did not study 2019, it cannot be ruled out that the policy changes were influenced by the increasingly critical media reports.

6.6. Conclusions

Overall, the two cases show that news media, in line with previous theories, served different roles in the risk governance decision making processes regarding specific earthquake risks: as democratic fora, as agenda setters, and as strategic instruments for network actor communication. In both cases, media attention around earthquake risks was largely risk-event driven, as this is more newsworthy than non-event risks and focuses on dramatic and direct consequences. This underscores studies that contend that media logic is biased towards sensational stories and events (Bennett, 2009). According to our respondents, media logic limits the agenda setting role of media in risk governance processes and can have adverse consequences for risk governance networks. Governance network actors' tendency to focus on techno-scientific information (and thus low newsworthiness) seriously hinders media's role as democratic fora and limits news media's reporting about the risk, thus reducing the agenda setting role.

6.6.1. Theoretical mechanism

The two cases show that media can play different roles in social amplification or attenuation of risk. News media as democratic fora can amplify risk as a social construct by disseminating information and diverging opinions and creating more awareness, even in the absence of increasing (or new) physical risk events. With regard to the fundamental question in SARF about *what is amplified*, our study provides two answers. First, awareness of a risk is amplified, as more

messages become available about the techno-scientific aspects of that risk, particularly perceived adverse consequences. The perception of consequences may differ between individuals, stakeholders, and communities. It can lead to discussions and ambiguity, as Poumadère and Mays (2003) and Busby and Onggo (2013) argued, that may further shape the development of perceptions of the risk as a social construct. Second, interviewees in Italy reported that media attention led to stigmatization of the region, adversely affecting the region's recovery. These secondary adverse effects can at least to some extent be attributed to media, which thus amplify the material damage.

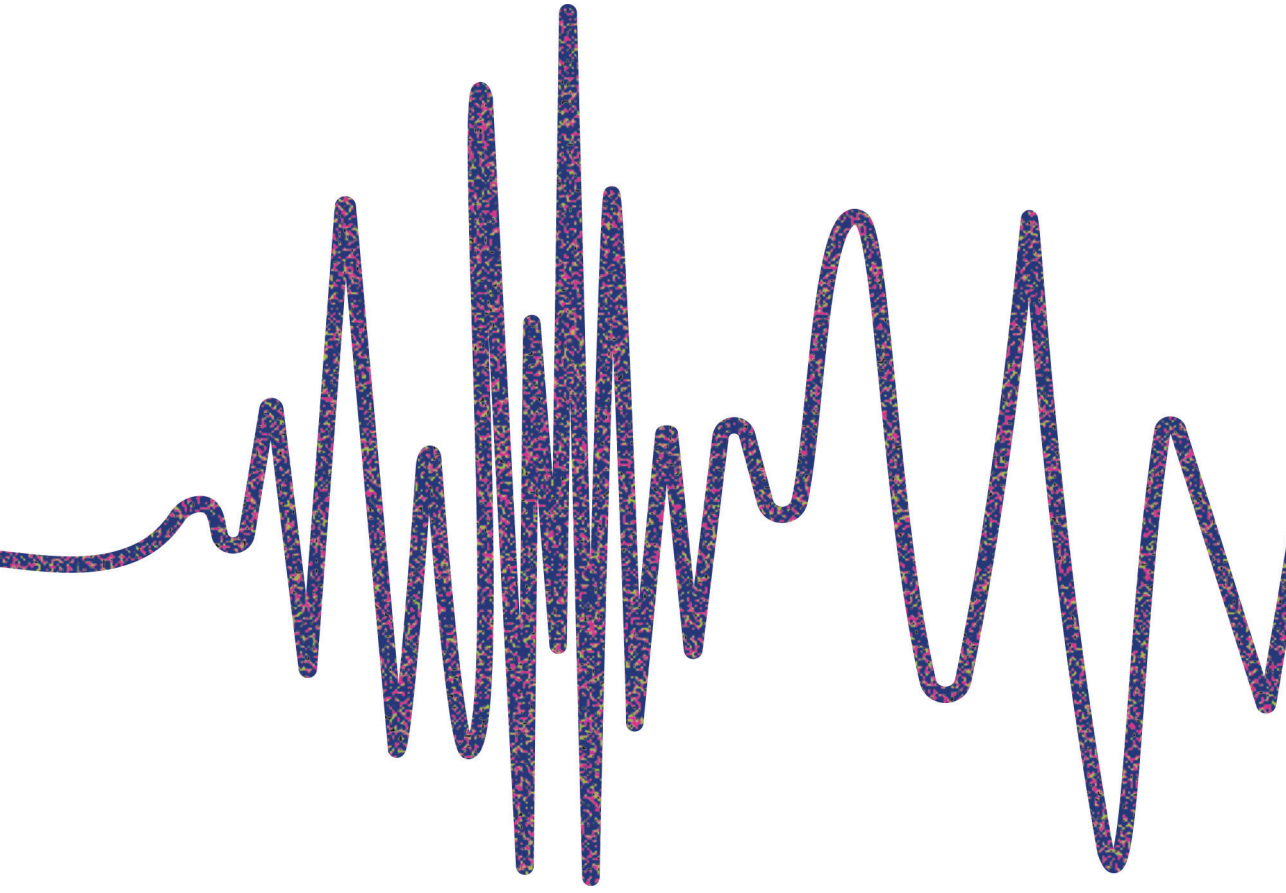
On the basis of interviews with a wide variety of stakeholders in two risk governance networks, our study suggests that decision making in earthquake risk governance networks shows resilience against short-lived media influences. In the governance of earthquake risks, media logic overrules other institutional logics only for a short while and not in the long run, when media play only a democratic fora role. This conclusion nuances existing literature arguing that media logic overrules other institutional logics (Mazzoleni & Schulz, 1999; Strömbäck & Esser, 2009) and adds to SARF that media play different roles in the creation of ripples that reach the political arena.

6.6.2. Limitation of the study and future research

A limitation of this study is that it focuses only on the governance of earthquake risks in two cases. The study's empirical generalizability may thus be limited, as risk dynamics are context dependent (Wardman & Löfstedt, 2018). Second, the interviews were held in 2017 and 2018, and, in the Dutch case, the drilling volume was lowered dramatically in 2019 with the aim of mitigating future earthquakes. Future research could investigate whether the media influenced this decision. A third limitation is that this study is based only on interviews with the most important stakeholders in risk governance networks. Media actors themselves and other parties were not interviewed. Future research, including interviews with journalists, will further add to the understanding of the media–risk governance interaction, *the weakest link in research about the social amplification of risk* (Howarth, 2013).

Appendix 6.A respondents

	Respondent Organization Dutch Case	Respondent Organization Italian Case
1	Ministry of Economic Affairs	National Reconstruction Commission
2	Ministry of Economic Affairs	Marche Region Communication Center
3	Ministry of Economic Affairs	Regional Reconstruction Group
4	Groningen Province	Assisi Municipality
5	Middle Groningen Municipality	Norcia Municipality
6	Middle Groningen Municipality	Local Community Preci
7	Groningen Safety Region	Local Group Hospitality Displaced Citizens
8	Groningen Safety Region	Local group *I Love Nortica*
9	National Coordinator Groningen	Local group *We are Norcia*
10	National Coordinator Groningen	Geology Camerino
11	Local Group *Gasberaad*	Association of young farmers in Marche
12	Local Group *Gasberaad*	Campi di Norcia
13	Local (Action) Group *Groninger Bodem beweging*	Sviluppumbria Umbria
14	Royal Netherlands Meteorological Institute (KNMI)	University of Perugia Cultural and Communication Processes
15	Dutch Petroleum Company (NAM)	Geology University of Perugia
16	Dutch Petroleum Company (NAM)	
17	State Supervision of Mines	



Chapter Seven: Systematic biases causing underpreparedness of risk governance networks and undermining contingencies planning practices.

Abstract

In this study, we investigate why governance networks are under-prepared for earthquakes. Based on interviews with representatives, we identify systematic patterns and conclude that governance networks in Italy and The Netherlands struggle with several biases causing failed contingencies planning. In both countries, bureaucracy causes inertia which hinders the governance of preparedness. Consequently, decisions required for activities to prevent/mitigate hazardous events, prepare emergency response and recover after an event, are not taken in time. Risk policy and politics in both countries focus mainly on short-term horizons and fail to learn from previous events. In Italy, where communities face catastrophic earthquakes, crisis management in the emergency phase is adequately organized, but pessimism/fatalism enables a status quo in risk policy and politics concerning emergency preparedness and recovery activities. In The Netherlands, optimism bias about the earthquake risks contributed to a status quo for gas drilling policy and politics in favour of economic benefits. However, a disjoint change from an optimistic to a pessimistic view about the impact of earthquakes contributed to rapid change in prevention and mitigation measures. Both in Italy and The Netherlands governance network actors have contingency plans available, but the governance of preparedness is suffering from systematic psychological biases.

This is an adapted version of the currently reviewed article:
Systematic biases causing underpreparedness of risk governance networks and which undermine contingencies planning practices: A double international case study on earthquake risk in Italy and The Netherlands (under review)

7.1. Introduction

Worldwide, societies and communities face devastating consequences of after disaster such as tsunamis like the one in Indonesia (2004), hurricanes like *Katrina* (2005), or earthquakes such as in New Zealand (2016). Duran et al. (2011) reported that annually at least 500 natural disasters are recorded, killing on average 70,000 people and affecting over 200 million people. Knowledge and expectations that comparable hazardous events may happen again, or may occur in other regions, pose severe threats to humans living in risk-prone regions. Not only major events with such catastrophic potentials threatens citizens; much smaller natural and man-induced hazards can also cause harm and create a need for citizens to protect themselves, respond to actual hazardous events, and recover and rebuild after mishaps. Communities and regions need to be rebuilt natural catastrophes and other hazardous events for human lives, economies, infrastructure, and culture.

Citizens expect governments to focus on the prevention of risk, and to take care and rebuild/compensate after hazardous events have taken place. Usually, governments establish institutes and institutions that address risk management including hazard forecasting and risk assessment. Besides governmental bodies, other actors in society engage in institutional structures and socio-political processes concerning risk. Such risk governance networks aim to prevent and reduce the negative impacts of hazardous events (Klinke & Renn, 2019 p.2).

Studies about the governance of recurring hazardous events such as earthquakes, tend to focus on emergency response during, and recovery in the aftermath of the events. Besides, scientific papers focus on predictive models to estimate magnitudes, frequency and adverse consequences of disasters and other risks. Evidence shows that citizens usually remain unprepared or underprepared for natural and man-made hazards (Adame, 2018). Preparedness encompasses activities as diverse as risk analysis, preparedness planning, resource allocation, training and exercises, deployment in real events, and feedback and learning (Baker & Ludwig, 2018; Njå,1997; Perry et al. 2001).

A lack of preparedness may include insufficient risk analysis or the absence of legal instruments, the lack of infrastructural and organizational planning and resource allocation, the absence of training and exercises, no deployment in real events, and limited feedback and learning (Njå, 1997; Baker & Ludwig, 2018). Existing research predominantly describes preparedness practices of individuals and households

(e.g. Eiser et al. 2012; Maidl and Buchecker, 2015; Goltz and Bourque, 2017; Shapira et al. 2018). For example, Becker et al. (2017) showed that households often fail to adopt precautionary measures to reduce the adverse effects of an earthquake. In a study about local disaster preparedness in Pakistan, Shah and coworkers (2019) showed, based on interviews with informants from a series of institutions that local institutions are underprepared in terms of awareness and training, human resources, financial resources, infrastructure and equipment, and coordination. So, whereas individuals, communities, and nations may be able to minimize adverse effects by building capacity and organizing processes and action concerning risk preparedness, they often fail to do so. Balamir (2002) showed, in one of the few studies about changes in governmental preparedness planning, that after major earthquakes in 1999 in Turkey the conventional approach in disaster policy has been restructured with greater emphasis to mitigation efforts, and the introduction of contingencies planning practices. However, participation of local and non-governmental organisation remained weak in the centralized governed structure according to Unlu, Kapucu and Sahir (2010). That the adverse effects disasters are to a large extend the result of mismanagement is known for a long time already (Wijkman and Timberlake, 1984). Corbacioglu and Kapucu (2006) argued that in disaster environments organisational learning from past disasters is often absent, although particular events may create substantial changes. Medd and Marvini (2005) pointed at the need for social sciences to develop research that critically engage with the different understanding of resilience in order to move from policy and politics approaches of crisis management to governance of preparedness. However, while disasters of all scales continue to grow both in magnitude and frequency (Gibson, 2015) little attention is paid in the scientific literature to the roles of governmental institutions and governance actors in risk underpreparedness or unpreparedness (Madan and Routray, 2015).

Meyer and Kunreuther (2017) argued that underpreparedness of risk government systems and governance networks is very common and identified several patterns. They explained that humans fail to protect themselves because of six psychological biases that underlie decision making. Timar, Grimes and Fabling (2018) argued that these six biases can help to explain that potential (naïve) purchasers may buy buildings at prices far above marked value in earthquake prone areas of New Zealand.

In this study, we aim to contribute to a better understanding of biases that hinder the preparedness of earthquake governance networks in which civil society actors collaborates with government and other stakeholders, and which may undermine contingencies planning practices. The focus is on the preparedness of earthquake governance networks in two different cases of recurring earthquake risk; I) high magnitude (M>6) natural earthquakes that occur with low frequency in Italy, and II) mild, frequently occurring earthquakes that result from gas drilling activities in The Netherlands. A comparative study design was chosen in order to ascertain earthquake risk (under-)preparedness in two countries with different socioeconomic situations, different cultures, and different risk governance networks.

In the next section, the relevant literature on risk preparedness is examined, highlighting biases that can influence decision making processes and lead to underpreparedness. The third section presents the methodology and introduces the two cases. In the fourth section, the results are presented, followed by discussions and conclusions.

7.2. Risk governance and preparedness

The assessment, management, and communication activities concerning public risks require the involvement of a network of governmental and non-governmental actors (Özerdem and Jacoby, 2005), and in which collective binding decisions should be taken (Van Asselt and Renn, 2011, Nye and Donahue, 2000). Governance *embodies a horizontal organized structure of functional self-regulation encompassing state and non-state actors, bringing about a collective binding decision without superior authority* (Rosenau, 1992; Wolf, 2002, cited in Bouder et al. 2007). *Risk governance* is the translation of the substance and core principles of governance to the contextual decision making concerning public risks (Renn, 2008; Renn and Walker, 2008). In particular, risk preparedness aims to build the capacity of nations and communities to be better prepared and mitigate the natural disaster risk in their region as is formulated by UNESCO (2020). Although the UNESCO definition suggests that this is limited to disasters with a natural origin, it may also apply to 'natural' disasters, such gas drilling-induced seismicity, caused by human activities.

Public risk can be defined as: '*A situation or event where something of human value (including humans themselves) has been put at stake and*

where the outcome is uncertain' (Rosa, 1998 p. 8). A risk governance network thus deals with uncertain outcomes, and situations or events where various human values may be at stake. Different stakeholders may have different beliefs and perceptions about the situation and about the necessary action to deal with the situation/event. In principle, risk governance activities should enhance active approaches to prevent or mitigate the extent of risk and adverse consequences of risk event outcomes (Elsubbaugh et al. 2004; McEntire and Myers, 2004). The Hyogo Framework for Action 2005–2015, also known as The Hyogo Declaration, prepared by the United Nations International Strategy for Disaster Risk Reduction (UNISDR, 2005) states that '*risk preparedness aims at building capacity of nations and communities to better prepare for, and mitigate, the natural disaster risk in the region*.' By making decisions and carrying out action plans, they may optimize their risk preparedness (Renn, 2005; 2008; Renn and Walker, 2008). Pearce and coworkers (2020) state that "Even if it does not come, you should be prepared…". Adame (2018) argues that local institutions should adopt proactive approaches and engage in preparedness activities that strengthen the existing governance system to manage disaster risk. However, local institutions are facing many problems to do so (Shah et al 2019). Policy makers should focus on addressing challenges that could restrict preparedness to deal with disaster risk (Adame, 2018).

Risk governance entails various risk management processes that should not be isolated from one another (Perry et al. 2001):

1. Risk prevention or mitigation, actions by governance actors before a hazardous event takes place, primarily through measures that reduce casualties (e.g. setting norms and standards, production limits, land-use regulations, or information to the public);
2. Emergency preparedness, actions undertaken before the occurrence of a hazardous event or events, thereby enabling communities to respond actively when the hazardous event manifests. Emergency preparedness is especially important when the risk events are recurring. In both stages, the governance network can use media to inform others in society about the policy actions and plans made (e.g. hospital facilities or training of rescue workers);
3. Emergency response, actions directly after a hazardous event takes place, for example to reduce the number of victims and the amount of damage and disruption;

4. Recovery, actions taken to repair, rebuild, and reconstruct damaged, and restore disrupted, communities' social routines and economic activities.

Preparedness activities contribute to the seismic resilience of communities and regions, i.e. the ability of physical and social systems to withstand earthquakes and cope with disturbances. Bruneau et al. (2003) proposed a framework for the assessment and enhancement of seismic resilience, and distinguished four aspects:

1. Technical: the ability to assess the risk, to determine acceptable levels of earthquake strength, and relate cause and adverse effects;
2. Social: the ability to protect individuals and communities against harm and to provide social support when necessary:
3. Economic: the ability to provide financial support for preventive measures or victims, stakeholders' economic losses, and reconstruction;
4. Organizational: the ability to provide capacity, competence, and institutional structures concerning risk governance.

7.2.1. Decision making biases

1. Meyer and Kunreuther (2017) try to answer the question of why humans and organizations deal poorly with future risks. They postulate six psychological shortcomings that help to explain underpreparedness.
2. Myopia, the tendency to focus on a short future horizon. Decision makers prefer short-term outcomes over long-run investments because the immediate costs and the potential benefits can be seen. It is a well-known bias in the field of behavioural economics and decision theory (Kahneman and Tversky, 1982; Guttentag and Herring, 1997). Nevertheless, in other fields also, the myopia bias plays a significant role in the governance process (Mitchell, 2003).
3. Amnesia, the tendency not to learn from the past. Decision makers often react shortly after an event (post-event period) with protective measures (Baron, 2000; Schade et al. 2012), but, although emotions run high in the post-event period, no protective decisions are made later on.
4. Optimism, the tendency to underestimate the likelihood of adverse consequences of future hazards. So, even though statistical

data might show that a new risk event will occur, decision makers are likely to be 'immune' to the future risk (Slovic, 2000; Tversky and Kahneman, 1973). Decision makers underestimate the possibility of a disaster if one has not been experienced recently (Hertwig et al. 2004).

5. Inertia, the tendency to maintain the status quo when there is uncertainty about potential investment measures (Samuelson and Zeckhauser, 1988). It may be difficult for decision makers to take new paths of action. Pearce and coworkers (2020) identified that a fatalistic, rather tah an optimistic viewpoint of a community to be a reason to take no or limited action before a disaster.
6. Simplification, the tendency to select only a subset of relevant facts in making decisions. It results in decision makers often ignoring important implications for safety and financial stability.
7. Herding, the tendency to follow decisions taken by others. Decision makers are part of a network with the same norms and values, and it is difficult to disrupt these norms and values.

7.3. Methodology and cases description

A qualitative comparative case-study research was conducted (Blatter and Haverland, 2012). A consequence of the research design is that the result will not lead to direct generalizability for other risk governance networks (Hufen and Koppenjan, 2015).

7.3.1. Case selection and description

Two cases were selected in which recurrent earthquakes take place in Italy and The Netherlands.

The *Italian case* the focus is on earthquakes located on the convergence of the African and Eurasian tectonic plates, which move around 4–10 mm a year. Convergence sometimes causes strong earthquakes, but the frequency of earthquakes is much lower than in the Dutch case. However, when the seismicity-prone region is struck, the earthquakes cause fatalities, many injuries, and catastrophic material damage. Socioeconomic structures and citizens' physical state are also profoundly affected. An earthquake in L'Aquila in 2009, for example, resulted in 309 deaths, 70,000 people homeless, and 1,500 people injured (e.g.

Chiarabba et al. 2009; Pacor et al. 2009). In the aftermath of this earthquake, risk reduction measures and communication were extensively discussed and criticized (Alexander, 2010, 2014). A few years later, on 24 August 2016, another earthquake (M=6.2) hit parts of Italy, with 297 deaths and 365 people injured (Lavecchia et al. 2016). One month later, from 26 October 2016 onwards, a series of strong earthquakes (M=4.5, M=5.9, and M=6.6) struck three regions: Castelsantangelo Sul Nera, Norcia, and Preci. All these earthquakes indicate that earthquakes are a recurring natural phenomenon in Italy. This case is characterized by suddenly occurring disruptions, originating from natural sources, causing severe physical damage.

The *Dutch case* is different because it initially did not have a natural cause and the earthquakes manifest in a region with no seismic history. Since 1963 the Dutch State has allowed gas extraction in the northern province of Groningen, which has earned more than €280 billion in State revenues (Vlek, 2018). However, the extraction has affected underground stability, causing earthquakes in the region. Mainly magnitudes of less than 3 are registered, and until 2020 the maximum magnitude was 3.6 on the Richter scale. The relationship between gas extraction and seismicity was recognized in the early 1970s and first experienced in the early 1990s. However, for decades, the causality and the increases in frequency and magnitude over time were ignored in social and political debates (Schmidt et al. 2018). This changed in 2012 when, on 21 August, an earthquake (M=3.6) struck the small village *Huizinge.* State Supervision of the Mines (SodM) classified the strength of this earthquake as high risk. The SodM classification gave rise to a disjointed increase in media attention and served as a tipping point for newspaper content (X et al. 2019) The news media attention stimulated political actors to discuss the technological activity of gas drilling, but no concrete policy actions were taken. A few years later, on 8 January 2018, another earthquake (M=3.4) hit the region, this time in the village *Zeerijp.* This particular earthquake gave rise to a political review of gas extraction and led to governmental decisions to reduce future gas production in an attempt to prevent or mitigate events and damage (Perlaviciute et al. 2018).

7.3.2. Interviews and analysis

For this study, semi-structured interviews were held with various governmental and non-governmental representatives of national and local authorities, private actors, and local stakeholders. Of the 33 interviews,

15 in Italy, and 18 were held in The Netherlands. Each interview lasted between one and one and a half hours.

A single researcher conducted the Dutch interviews in Dutch. Two researchers conducted the Italian interviews in Italy. All the interviews were recorded and transcribed. The Italian interviews were translated into English to enable further analysis by the non-Italian researcher. In both cases, full anonymity was promised to encourage respondents to discuss sensitive topics about the perceived hindering factors in the decision making process. Names and functions are not used in the manuscript.

The respondents were asked about their involvement in the decision making process – the process itself, relations, activities, tipping points, dilemmas, consequences – and the influence on other stakeholders. At the end of the interviews, the respondents were allowed to raise other issues about risk preparedness.

The data analysis is based on an inductive approach, meaning that no prior codebook was used (Zhang and Wildemuth, 2009). The factors were extracted from the interview transcripts. The evaluation was goal-free (Scriven, 1991) and not focused on theoretical expectations. The inductive approach was used because it was essential to make no prior assumptions, to avoid answer steering. If a deductive approach had been adopted, the respondents would merely have indicated whether or not Meyer and Kunreuther's (2017) six biases were perceived, and this might have obstructed the study. In the follow-up analysis, the raw data were then connected to Meyer and Kunreuther's (2017) biases.

7.4. Results

7.4.1. Underpreparedness in Italy

Technical aspect: Although all respondents mentioned that earthquakes were expected, insufficient proactive emergency preparedness action was taken to ensure earthquake-proof buildings. A respondent stated that: '*It can certainly be said that the earthquake's effects were not prevented properly…*' Furthermore, all respondents argued that anti-earthquake regulations and seismic danger maps were outdated and should have been revised before the catastrophes. So, although respondents agreed that the catastrophic event could not be prevented as such, they argued that adverse consequences could have been mitigated.

Social aspect: The mindset and behaviour of citizens and authorities are themselves partly responsible for the problem, some respondents argued, i.e. they were not emergency prepared. As a consequence of the 2016 earthquakes, the region faced enormous economic losses because of the total collapse of tourism in the areas hit. The economic losses were devastating for local citizens. One respondent stated that the scope of these losses was partly a consequence of a cultural approach. It was mentioned that local citizens '*just accept*' the fact that they live in an earthquake-prone area and are not adequately prepared to respond appropriately, for example to a temporary decline in tourism. Also, although the knowhow to build earthquake-proof houses exists, several risk governance networks did not decide to build them. Respondents explained this as a cultural issue. At this point, some actors insisted on a long-term mindset change, whereby the region would be economically better able to deal with future earthquakes and become better emergency prepared.

Some respondents argued that earthquakes should not be regarded as '*just an act of God*'; rather, the local community should recognize that it had choices about its response to an earthquake. The protracted reconstruction and recovery period led to anxiety and social distrust. Attempts have been made to change the cultural attitude so that fear and anger do not dominate the impact of an earthquake.

Economic aspect: Some interviewees argued that, in spite of previous experiences, the governance network had a strong short-term focus, rather than a focus on long-term investments. However, the construction of earthquake-proof houses is possible, as was shown after 1997, some actors reported. In that year, another major earthquake struck the region, and, in the aftermath, some buildings and houses were rebuilt earthquake-proof. The same region was struck again on 24 August 2016. The earthquake-proof houses were damaged but did not collapse. Such risk mitigation and emergency preparedness activities concerning buildings could have served as a best practice for prevention measures, interviewees said. According to the respondents, many deaths could be prevented if adequate building regulations and procedures were implemented for all houses and buildings. However, (re)construction of earthquake-proof houses is costly, and the authorities are not always willing (or able) to invest in such safety measures.

Interviewees also reported the lack of financial support from the national government. Although there was strong support during the emergency response phase immediately after an earthquake, there was

a lack of commitment regarding long-term reconstructions. After the 2016 emergency response phase, when the recovery phase started, the network received insufficient financial support to affect day-to-day living conditions.

Organizational aspect: All respondents indicated that there was a lot of bureaucracy around risk preparedness activities and processes. Consequently, the many regulations that must be followed strongly adversely affected the speed of decision making processes. According to several interviewees, bureaucracy entails different aspects of compliance with regulations. First, some regulations aim to safeguard the landscape. This, however, caused severe problems for the speed of the reconstruction process. Second, administrative bureaucracy leads to slow procedures and decisions. Because of bureaucracy, many administrative delays arose or even resulted in a stagnation of the whole decision making process. Bureaucracy was hard to overcome in the network, because of administrative, cultural aspects, respondents argued. Also, the lack of financial support in the long-term for recovery and the preparedness activities for future mishaps can be explained by the strong bureaucracy regarding the reconstruction of houses and buildings.

Another issue addressed by several respondents is the mismatch between national regulations and local needs. An example of this mismatch, one interviewee said, is the provision of tents by Civil Protection. The tents were provided as an aid for citizens who had to flee their houses, but the tents were not suitable as temporary accommodation during cold winters. There are rules and procedures relating to receiving financial support, but each earthquake affects each village differently, making the risk extraordinary. Ordinary situations are much easier to handle, but an earthquake '*does not find room in the political-administrative culture of our country*', a respondent mentioned. Stakeholders argued that a more structured way of listening to the needs of territories would be required to define legislative and regulatory measures.

7.4.2. Underpreparedness in The Netherlands

Technical aspect: Interviewees reported that the actual risk was structurally underestimated for an extended period and that this hindered risk preparedness in The Netherlands, particularly prevention activities and emergency preparedness. The emerging risk was underestimated not only by citizens, but also by politicians and by governmental bodies involved in gas drilling policy. Before the earthquake in 2012, research

focused insufficiently on the emerging nature of the risk and the socioeconomic and psychological effects of frequent earthquakes. The risk was described by some interviewees as '*a disaster in slow motion*'. The lack of research and monitoring data negatively influenced the risk assessment of alternative risk management decisions, like reducing or terminating the gas production. Network actors stated that systematic research and monitoring in an earlier stage would have led to better predictions of the magnitude, frequency, and adverse societal consequences. The M=3.6 earthquake that struck Huizinge in 2012 was a surprise to the research community. Moreover, there was limited research on the causality between gas drilling and earthquake risk. Consequently, governmental authorities were not able to determine the level of gas drilling that related to a particular (acceptable) frequency or magnitude of earthquakes.

Social aspect: Some actors argued that there was an unwillingness to invest in proper knowledge; others argued that it was not unwillingness, but rather a lack of capacity. Furthermore, some interviewees argued that, as long as the earthquake did not result in fatalities and injuries, economic value overruled safety. Also, some actors in the network argued that the 'safety norm' set by SodM was arbitrary and that this (arbitrary) norm profoundly influenced the decision making process.

The earthquakes increased in strength and magnitude over time, but early signals were ignored for too long on all levels of the network because the benefits were significant, interviewees responded. Some actors argued that underestimation of the emerging risk was a consequence of stakeholders' conflicts of interest. Furthermore, it was influenced by the humanmade character of the risk. According to some interviewees, the lack of risk-reducing decisions led to a steep decline in local authorities' and citizens' trust in the Ministry and the Dutch Petroleum Company (NAM) concerning preparedness actions, and the responsible parties delayed decisions on purpose.

Actors also responded that, later on, when the earthquakes caused damage to houses and other property, governmental bodies looked at one another when payments for compensation for damage needed to be organized. This resulted in distrust of the risk governance network and the Ministry of Economic Affairs in particular.

Economic aspect: Some actors argued that gas extraction was necessary for gas supply security, especially in cold winters. Long-term investment was needed to make an energy transition from gas to alternative energy sources. A respondent stated that, in 2018, only

7% of energy in The Netherlands was sustainable and added that this was much too low and should have been at least 30%, 40%, or even 50%. Furthermore, local authorities argued that the yearly revenues were too attractive for the Dutch State and NAM and discouraged long-term investments in the transition towards other energy sources. A respondent even argued: '*The Dutch State is a gas addict*.'

The Netherlands lags far behind in alternative and sustainable energy sources, and this will have serious consequences, some actors argued. The gas transition will financially affect everybody personally in The Netherlands, and it will also affect the economy at large. It will be difficult for politicians to change the country's energy policy.

Organizational aspect: Although some stakeholders stated that it was reported as far back as the early 1990s that the risk would increase over time, this did not lead to risk mitigation decisions or emergency preparedness activities. Interviewees reported that the discussion about the risk and benefits of gas drilling created a dilemma for the various involved authorities. The non-governmental network actors also faced a constant conflict about the optimal balance between risk and benefit. For some actors (the Dutch State and NAM), gas extraction provided major revenues, whereas for others (local authorities and citizens) the gas drilling had significant adverse effects.

Governance network actors reported that proactive risk mitigation policy measures were not taken to the extent that they should have been. Long-term solutions (earthquake-proof buildings or energy transition) were too complex and too expensive, with too many stakeholders involved and interconnected. A long-term socioeconomic alternative for gas drilling was unattractive according to several interviewees, and thus it was unlikely that political actors would make such decisions.

Furthermore, several interviewees pointed to the many roles of the Ministry of Economic Affairs concerning the gas drilling issue. Three departments of this Ministry are involved; one is responsible for ensuring gas supply for Dutch citizens, another for ensuring safety, and the third has to focus on economic development. These departments' different focuses lead to an association and alignments with different stakeholders outside the Ministry, complicating the Minister's decision making process.

Complexity and ambiguity also arose in the handling of damage claims because the company (NAM) that caused the damage was also given the mandate to decide about compensation. According to interviewees, after 2012 new organizations and commissions were

established and added to the risk governance network, thereby increasing the complexity of the network and further confusing the distribution of responsibilities within the network. It therefore became more difficult to take concrete actions in due time. At the same time, network actors came under strong pressure to take direct actions after 2012. Public opinion changed dramatically, and citizen organizations requested mitigation, response, and reconstruction actions. However, a respondent argued that all network inter-dependencies are built on four-year cycles between national parliamentary elections. Such as cycle is too short to ensure a long-term vision, although the need for a long-term vision was clear. Another respondent mentioned: '*it is like a pressure cooker; you must come up with a holistic plan for the region within eight weeks. I have the impression that they do not look more than four years ahead. That's it. Nothing like a future vision…*'

7.5. Discussion and conclusions

During the emergency response phase, directly after catastrophic events in Italy, almost no hindering biases were reported by interviewees and contingency plans worked well in practice. Only bureaucracy was mentioned as a (minor) cause of mistakes in logistic support during this emergency response phase. In The Netherlands, the mild earthquakes did cause damage, but emergency response immediately was adequate according to most respondents. Consequently, neither in Italy nor in The Netherlands substantial hindering biases were reported during the emergency response phase. However, from the interviews in The Netherlands and Italy, it is clear that several biases contributed to underpreparedness for earthquake risk. Particularly the phase of prevention/mitigation, emergency preparedness and recovery, for both countries, biases are found, although differences between the two countries are identified.

7.5.1. Prevention/mitigation and emergency preparedness in the case of natural disaster:

In Italy, earthquake prevention is not an option for the risk governance network because of the catastrophic magnitude of the earthquakes and the geophysical origin. However, before an earthquake, actions can be undertaken to technically mitigate the impact and then facilitate an adequate response to a catastrophe which is by itself not unexpected.

This is consistent with Adame (2018), who argued that despite the difficulties and the ambiguous nature of hazard forecasting, preparedness can create an umbrella effect of protection. Interviewees indicated that the adverse impact could have been reduced if something had been learned from some good practices in the past and also if risk maps had been updated. The amnesia bias is thus prominent in the Italian case. It combines primarily with the cultural attitude that one has to accept the consequences of a natural phenomenon. This suggests a pessimism/fatalism bias, as opposed to Meyer and Kunreuther's (2017) optimism bias, but confirmed the view of Pearce et al (2020) that fatalism contributes to a lack of preparedness. However, a community with a fatalistic viewpoint, for example by accepting 'God's will' does not fall short of recovery initiatives shortly after a disaster.

In Italy, little was invested in making the buildings earthquake-proof; this also can be seen as a myopia bias, focusing on the short-term rather than the long-term horizon. There seems to be substantial discussion in Italy between stakeholders about risk preparedness, suggesting that herding is less prominent in Italy. However, bureaucracy hinders mitigation activities, an inertia bias during prevention, emergency preparedness and recovery phases.

In Italy, after catastrophic earthquakes happened and recovery action was needed, communities suffered mainly from bureaucracy, inertia, myopia, and amnesia bias. Overcoming the amnesia, it was shown in Italy that houses could be constructed earthquake-proof. However, rebuilding and other recovery activities, in most cases, similar to previous events, focused on short-horizons and learned little from the past. Communities were waiting for future mishaps that might cause the same damage and could not be prevented, a pessimism/fatalism bias.

7.5.2. Prevention/mitigation and emergency preparedness in the case man-induced risk:

Since gas extraction started in The Netherlands, the ongoing short-term focus was on the annual economic revenues from gas sales, energy security for industry and households, and the employment of citizens, and this dominated governmental decision making. Many authorities' technical underestimation of the risk for a long period can be understood as optimism as well as an amnesia bias. Even when earthquakes started occurring and increased from the 1990s onwards, the time horizon remained short term, a myopia bias. The gas dependence – in terms of energy supply and economic revenues – can be interpreted as

a simplification bias of the risk and benefits of gas drilling. The delayed or prohibited development of a long-term vision and the failure to find solutions regarding risk prevention, mitigation, response, or reconstruction activities can be characterized as an inertia bias. Moreover, although many stakeholders were involved in the governance of gas drilling and risk preparedness, almost no actor proposed alternatives for the gas drilling policy, a herding bias. The multi-layering of organizational structures in The Netherlands severely hindered decision making and risk preparedness. The number of actors involved in the decision making process is so significant that it prohibits proactive decisions; each actor is dependent on another's actions.

Although interviewees did not report it as such, it seems that risk governance actors also showed aspects of optimism bias, probably expecting until 2012 that future gas-induced earthquakes would not increase in prominence. At least in the last couple of years before 2012, they did not show that anything had been learned from the emerging frequency and magnitudes of the earthquakes – an amnesia bias – particularly regarding the technical aspects of risk preparedness. So, before 2012, all biases mentioned by Meyer and Kunreuther (2017) seem to be relevant for the Dutch risk governance network. Consequently, gas drilling remained near the status quo, as Baumgartner and Jones (2009) also observed for various other subdomains of policy and politics (see also Opperhuizen, Klijn and Schouten, 2019). The core of the biases entailed the technical and organizational aspects of risk preparedness in The Netherlands, and less the social and economic aspects.

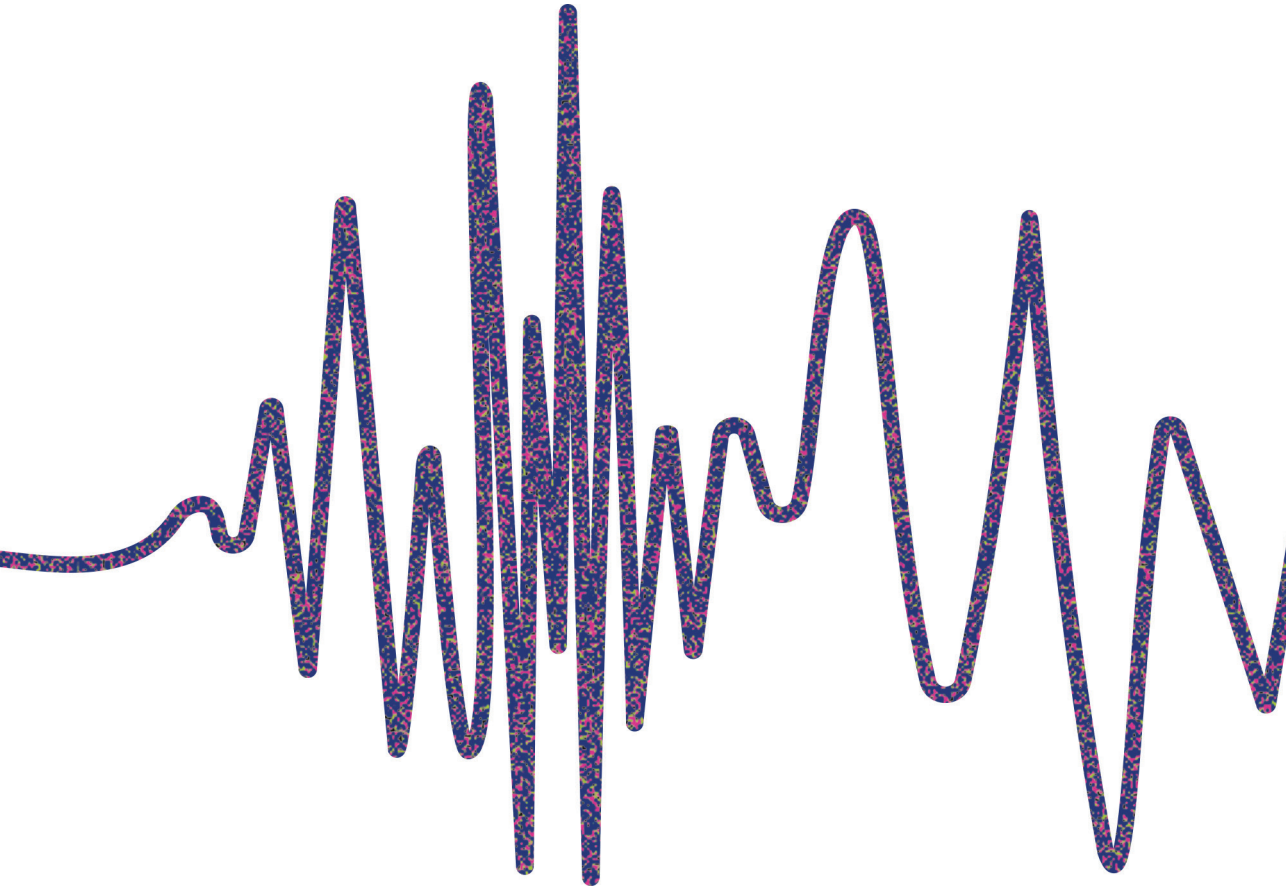
After 2012, the status quo policy in The Netherlands changed in a disjointed manner; this can be interpreted as resulting from herding and simplification biases. Also, the SodM's report in January 2013 showed that optimism about future earthquake magnitude was naïve, and optimism seemed to be replaced by a pessimism bias. Herding and simplification can also be observed, because the overall focus of the risk governance network changed rapidly from mainly on benefits to mainly on risk. However, the inertia bias persisted, as the bureaucracy became even more prominent as more actors entered the risk governance network. Actors reflected critically on this period of institutional ambiguity. Inertia stimulated social distrust of the risk governance network, resulting in even slower and more complex decisions. Also, as all the actors are related and mutually dependent, they tended to follow decisions made by others. The implementation of policy measures for damage recovery takes a long time.

The myopia bias seems to be substantial in the risk governance network as there is massive pressure on taking direct actions and 'showing results'. However, little was learned in The Netherlands during the different phases of the development of the drilling-induced earthquake risk. Until 2012, almost no progress was made in risk preparedness, which may be partially be explained by a lack of herding of stakeholders focussing on risk. Risk was still under-estimated, social distrust neglected, economic alternatives not developed, and the complexity of the risk further increased. Although many short-term actions were initiated, the implementation of policy measures for damage recovery, for example, took years and remained unclear for an extended period.

7.6. Conclusions

Based on the responses of risk governance actors in Italy and The Netherlands we conclude that underpreparedness regarding technical aspects was less for natural catastrophic earthquake in Italy, than for mild, technology-induced earthquakes in The Netherlands which slowly emerged over time. A short-term focus and learning little from the past are important biases that cause policy and politics to maintain the status quo for extended periods, paying insufficient attention to risk prevention or emergency preparedness. For a mild, technology induced-earthquake risk, an optimism bias may further support this status quo policy. For natural catastrophic risk, also a status quo policy may be enabled, but by a pessimism/fatalism bias rather than by optimism. Furthermore, inertia due to organizational bureaucracy is a prominent bias for risk governance networks both in The Netherlands and in Italy which adversely influences technical, economic and social aspects of risk preparedness. It is a major hindering factor in the decision making process concerning risk preparedness.

Contingency plans are often available at the level of governance network actors, but governance of preparedness at the level of the network fails. Overall we conclude that underpreparedness in technical, social and economic aspects of preparedness almost all relate to lacking organizational aspects of the risk governance network. Inertia due to bureaucracy, myopia and amnesia of all stakeholders and fatalism of the population can be identified as the main biases of underpreparedness risk governance network against recurring hazardous events.



Chapter Eight: Conclusions and discussion

This thesis aims to provide more insight in the role media play in risk governance and its dynamics. I particularly focus on the question when and how media play a role in the social construction of risk and what the media's influence is on risk governance processes in the case of emerging technology-induced earthquakes and natural earthquakes. In this final chapter, the conclusions and discussion are presented. This chapter is comprised of four sections. First, in 8.1, I answer the four subsidiary research questions of this study and elaborate on the conclusions of this thesis and its contributions to the literature. Next, in 8.2, I present the main conclusions that can be drawn from this study and provide an answer to the main research question. In section 8.3, I address the limitations of this study. In section 8.4, I give recommendations for practice and in 8.5. I provide suggestions for future research.

8.1. Answering the subsidiary research questions

The main research question is formulated as follows: *How and when do media play a role in the social construction of a risk issue, what is its influence on risk governance processes of emerging technology-induced earthquakes and natural earthquakes?* The main research question was split into four subsidiary research questions:

1. When and how do media frame and reframe an emerging risk issue over time?
2. What is the dynamic between media, political, and policy agendas?
3. How is the news media's role in the risk governance decision making process perceived by network actors?
4. Which factors influence the risk (under)-preparedness of governance actors and networks?

The five empirical chapters of this thesis all contribute to answering one or more of these questions. The next section presents the results of the empirical chapter to provide answers to the subsidiary questions.

8.1.1. When and how do media frame and reframe an emerging risk issue over time?

In chapter 6, risk governance actors mention that after the catastrophic earthquakes in Norcia, Italian media covered the issue and the risk

governance network took action. The catastrophic events were immediately perceived and adopted by media as extreme risk signals. However, this chapter also shows that even while such catastrophic events cause tremendous harm to daily life, media attention faded soon after the catastrophic events. The risk governance network actors mentioned that media almost neglected the recurring natural earthquakes in the long run after the event, causing limited opportunities for social deliberation. Only the catastrophic event itself was meaningful (newsworthy enough), and delivered incongruent information for media.

But when do media frame and reframe a risk issue without a catastrophic event ? In chapters 3-7, I focus on such a risk in the Dutch gas drilling case. The results of chapter 3 and 4 show that due to the lack of a catastrophic risk event with high visibility for the general public, media coverage is low for long periods. While the results show that newspapers did cover the increase in frequency and magnitude of earthquakes since the 1990s, this did not result in a disjoint volume expansion or a change in the content of the reporting. These studies show that the local newspaper started to increase covering the news a few years earlier than the national newspapers, probably because there were only negative consequences of the gas drilling activity for the local community. I found that proximity is thus a meaningful element for the newsworthiness of the issue for the media.

In the chapters 3 and 4, the data show that the real physical events increase over time, but media do not respond to these risk signals. Even when there is a 3.6 Richter Scale earthquake in Huizinge on August 2012, which caused more damage than previous earthquakes, it did not trigger the expansion of media reporting. Only a slight increase in the number of articles is observed directly after this event. Even in the situation of the most prominent event, this was not a key event for media to report about. This finding is in contrast to the Italian case.

The results of chapters 3 and 4 show that there is a tipping point in the volume of media reporting in early 2013. This tipping point arises with a delay of approximately five months after the Huizinge earthquake. Thus, the increase of media attention cannot only be explained by the magnitude or frequency of the earthquakes. To explain this disjoint moment of media change, I performed a content analysis in chapter 4. This chapter shows that sub-topics used in newspaper articles until the end of 2012, mainly emphasize beneficial aspects (sub-topic *´benefits´)* of gas-drilling and covers 'technical' information (sub-topic *´physical hazard*' and '*material damage')* about the events. However, from

early 2013 onwards (period of disjoint change), media introduce new sub-topics in their coverage. These new sub-topics are emotion loaded and related to safety, responsibility (sub-topics '*decision making*' and '*apologies*'), and human interests (sub-topic '*the feeling of citizens*' and '*disadvantage position of the region*').

Additional support for the disjoint change of media attention is provided in Chapter 3. I show that not only the use of sub-topics changed in a disjoint manner from 2012 to 2013; also the sentiment of the journalistic articles changed. Before 2013, there is limited use of *dramatization* bias by media. In 2013 onwards, the use of a *dramatization* (*conflict of political parties* and *conflict of counter values*) bias sharply increased when weighed against the rise of other biases i.e. personalization and negativity. Especially the value conflict between *economic values and safety values* dominated the media debate which suggests a conflict with *economic values*. Chapters 3 and 4 show additionally that the various newspapers all use similar sub-topics and biases.

Above is shown that in 2013 media coverage disjointly change both in volume and in content. But it can still be questioned why media suddenly referred to earthquakes as a *safety issue.* Or in other words, what other meaningful elements and incongruent information became available to change the newsworthiness of the issue? The answer comes from the results presented in chapters 4 and 5, where I study media reporting, political reports, and policy documents. The results show that in January 2013, governmental authority State Supervision of the Mines classified the magnitude of 3.6 as a 'high risk'. Qualifying earthquakes as a 'high risk' *safety issue* by the media was the result of the 'norm-setting' by the policy authority. Therefore, the key event for the media in the Dutch case seems to be the combination of the Huizinge earthquake and the classification by a risk governance actor. I found that State Supervision of the Mines added 'safety' as a newsworthy element in the public debate.

In sum, the high visibility of a *key event* is required to attract the attention of journalists immediately. Media report when catastrophic earthquakes on their own right are newsworthy for media; prominence can serve as a newsworthy key event to trigger journalists. However, the prominence of the risk is not always sufficient on its own right. In the absence of strong, hazardous effects with high visibility, other triggers are required for the media. Exceeding a safety norm value can also serve as the trigger for media to report on a risk issue. When media are aware of the risk issue, they reframe the debate by applying emotional loaded content and apply mediatisation biases.

Connecting the findings with the theoretical background presented in chapter 2: Media – Risk

The simple answer to the 'when´ do media frame and reframe a risk issue question is, according to Kepplinger and Habermeier (1995): when key events add newsworthy elements to the risk. They argue that in the absence of such key events, risk situations may be perceived as certain situations which by themselves do not contain newsworthy elements. Based on my findings I agree with Keppelinger and Habermeier (1995) that key events are critical to create a media wave. In this study I argue that underreporting by media may last long when there is no key event for journalists. In this thesis I find several explanations of the lack of intense media coverage on earthquake risks: 1. the longevity of the emerging risk (Chapters 7), 2. lack of catastrophic effects of the earthquakes (Chapters 6 and 7), 3. the technical nature of the available information which may hinder journalists to make the issue salient (Chapters 5 and 6), and a lack of controversy and conflict (Chapters 3, 4 and 5). The same factors may help to explain why media attention after a catastrophe can be low.

Connecting the findings with the theoretical background presented in chapter 2: Media – Policy

Baumgartner and Jones (2009) did not investigate the roles of the media in detail in the disjoint disruption of policies. In this thesis I show that the introduction of (value) 'conflict' and emotion loaded sub-topics in media reporting are vital during the period of expansion of issue attention. It is in line with previous research indicating that media tend to report on emotional subjects (Mazzoleni & Schulz, 1999; Bennett, 2009). The media is strongly focused on conflicts as is shown in the increase of the sub-topic *safety issue, feeling of citizens* and also by applying *dramatisation bias.* The focus on conflict by media play formed already the foundation of conflict expansion theory by Schattschneider (1975), were he mention that elements of conflict initiate or stimulate public awareness. Elements of conflict can also set the agenda, as is addressed by Cobb and Elder (1983). In addition, Lörcher and Neverla (2015) also found that dramatic sub-topics relating to human interest and conflict play a critical role in longitudinal framing studies.

8.1.2. What is the dynamic between media, political, and policy agendas?

When only the technical aspects of a risk are shared, media reporting is reasonably stable at a low level both in volume and in content as I show in Chapter 3 and 4. To get a better insight in how a risk becomes socially constructed I performed a content analysis of political documents and policy documents in chapter 5. The results in this chapter show that a lack of media attention is mirrored in the political arena, and vice versa. The results also show that when the 'high risk' notion of the State Supervisions Of Mines in early 2013 was made, the risk issue became not only highly salient for media, but also for politics. I found a strong overlap in media sub-topics and sub-topics addressed in parliamentary debates. I found this in the situation of underreporting (attenuation 1990–2012) as well as in the situation of overreporting (amplification 2013 onwards). We have to note here that in this thesis reports of the inspectorate are use to reflect policy decision. We justify this by the intertwined situation of government and governance of gas drilling in The Netherlands. SodM was many years a part of the 'technical subdomain' responsible for gas drilling policy (Baumgartner & Jones, 2009)

In contrast to the strong correlation between the media and the political agenda, the supervision policy agenda of State Supervision of Mines (SodM) is a different one. The sub-topics addressed by SodM hardly correlate with sub-topics that are used in the media and the political debates. Only the sub-topic safety issue, introduced by SodM in 2013, correlates well between the three agendas. Other sub-topics, that add emotional value, were not rippled towards the regulatory agenda. Therefore, I argue that the classification of a risk event as 'high risk' initiated a chain reaction, since it triggered the agenda of media (see also 8.1.1), which on its turn, rippled towards the political agenda, but SodM followed its own agenda. This illustrates the independent role such an authority plays in the risk government.

In sum, redefinition by the regulatory authority of earthquakes as 'high risk' was the tipping point for media and political agendas. In the coverage after the tipping point, media apply media biases (see chapter 3) and emotional loaded content. The emotional news value was rippled to the political agenda, while it was not rippled towards the regulatory agenda. There is a dynamic relationship between the media and the political agenda, but the policy agenda follows its own course.

Connecting the findings with the theoretical background presented in chapter 2: Risk – Policy

The finding that media and politics influence each other while the regulatory agenda follows its own course, is in contrast with most theory. It is usually assumed that media attention also influences the policy agenda and implementation (Cobb & Elder, 1984; Baumgartner & Jones, 2009). In this thesis, I find support for just the opposite; the regulatory agenda seems to take its own course, and this has a substantial impact on the media and political attention. This finding adds to the concepts of media attention and agenda setting.

Connecting the findings with the theoretical background presented in chapter 2: Risk – Policy

According to Goffman (1974), reframing can occur at any time when incongruent information becomes available, and new meaningful elements arise about the situation or the issue. Goffman's statement provides an answer to 'how' media frame and reframe on a risk issue, just by adding new meaningful elements and incongruent information. This thesis adds to the existing literature that redefining the risk issue by a governmental agency can function as an untimed trigger for media to start reporting on a risk issue. Redefining the risk can then be interpreted as adding incongruent information, as Gramson and Modigliani (1989) postulated. After reframing the issue by the regulatory policy actor it is no longer perceived as a technical issue regulated in a policy sub-domain of society but as a controversial issue about risk and benefits by media and politicians. However, this thesis also shows that when governmental agencies do disclose not incongruent information and remain to be part of the technical subdomain, intertwined with other stakeholders which have commercial interest, risk policy may suffer from inertia and herding biases.

8.1.3. How is the news media's role in the risk governance decision making process perceived by network actors?

In chapter 6, I interviewed risk governance actors (but not representatives from media stations) to get at better insight in how they perceived the role of media in the governance decisions making process. I especially focused on three roles media have in a governance network; media as democratic fora, as agenda-setter, and as a strategic instrument. Chapter 6 shows that in a situation of a catastrophic risk event (Italy) and in a situation of emerging risk (the Netherlands) governance

actors in both countries mention the three different roles. However, between the cases there are differences which can be explained by the nature of the events and the newsworthiness of it; gradually technology-induced emerging risk versus disruptive earthquake risk caused by natural processes. Both cases show that in the studied period of time, the agenda setting function of the media is limited to short-term political agendas. According to the governance network actors, it hardly reaches long-term policy agendas.

In addition, the watchdog function of media to keep the government accountable was limited the Italian case. The watchdog function was initially also limited in the Dutch case before 2013, which changed after 2013. Since in the Dutch case the risk events are a consequence of human activities which entails both risks and benefits (financial gain/gas supply), different governance actors tried to use media for their vested interests. In Italy there are no conflicting vested interests on whether it is an acceptable risk for society, since earthquakes are a result of natural processes with no benefits for society. In this situation, the agenda setting role is almost absent, but only used to generate financial resources for the recovery of the region. The study shows that Italian governance actors perceive media mainly as a source of information for citizens and stakeholders during the catastrophic event.

Governmental actors in both countries report difficulties in using news media for strategic communication because of the strong focus of media on sensationalism. They have difficulties to use media to bring the information and opinions to broader audiences since they mainly transmit technical-factual information. The technical information provided by risk governance network actors often does not to pass a threshold of newsworthiness for the newspapers (see also chapter 4). It suggests, that when media tend only to mediate information of risk governance network actors, the actors themselves should emphasize particular elements of risk, in order to make the issue more salient for journalists.

Chapter 6 additionally shows that the strong focus on sensationalism can have adverse consequences for the risk governance action in the network. For example, it contributes to additional adverse consequences as the repulsion of tourists from earthquake-prone regions in Italy. Sometimes media are not seriously interested in facts, and develop a *self-created reality* (see Chapter 6). In such cases, media logics undermines the watchdog function. Besides, according to the network actors, the power to improve decision making in the risk governance

network is undermined, and not helpful to be prepare for future risk events, as is shown in Chapter 7.

In sum, media fulfil different roles as democratic platform, agenda-setter and a strategic role, but these roles are hard to grasp according to risk governance actors. The agenda setting role is partly determined by the nature of the risk (catastrophic and natural versus gradually technology-induced risk), the risk needs to be prominent enough due to its catastrophic effects, visibility or social impact for media to address it. The risk governance actors find it difficult to communicate their (technical) risk information to the media because they have trouble understanding the media logic. Media are important in sharing information about risk events and critically assessing the actions of governance network actors, but their focus on sensationalism can hamper the risk preparedness.

Connecting these findings with the theoretical background presented in chapter 2: Media – Policy

In this thesis, I show that network actors indicated that they face difficulties in bringing their issues and interests to the attention of the journalists. Risk governance actors want to make better use of the strategic and agenda setting roles of the media, and consequently that media can play a bigger role in risk governance. However, the gap between the messages network actors want to bring to the broader audience, and the threshold of newsworthiness of the journalists seems to be substantial. The adoption of risk signals in society is dependent on the professional rules of the media. It means that risk signals have to be aligned with newsworthiness in line with their logic since media have to satisfy their consumers (Altheide & Snow, 1979; Binder, 2015). To overcome the gap between network actors and journalists, network actors need to take media logics into account when they want to use the agenda setting and strategic roles of media.

8.1.4. Which factors influence the risk (under)-preparedness of governance actors and networks?

In the previous paragraphs, I show that a lack of media attention contributes to underpreparedness for risk governance actors. Moreover, also other factors influence (under-)preparedness of governance actors and networks. In Chapter 7, I study potential decision biases of risk governance actors (excluding media) in the network, which contribute to technical, social, economic, and institutional underpreparedness. I

show that the main factors that hinder preparedness are different in the case of technology-induced emerging risk by human activities versus disruptive earthquake risk caused by natural processes. Although the catastrophic earthquakes in Italy have a recurring character, little seems to be learned from previous cases (amnesia bias). In The Netherlands, the gas-drilling region had no history of earthquakes before 1990, and amnesia was not a vital hindering bias. Another difference is that in an emerging risk the prominence of the earthquake risk can be unclear in terms of frequency, magnitude, and adverse consequences in the future, resulting in optimism bias. It resulted in a lack of risk analyses and assessments in the early stages of the emerging risk, consecutively in a lack of societal and political attention (chapter 5). The risk was underestimated for a long period, and the technical dimension of risk was under-prepared. While there is underpreparedness in the technical dimension in the Dutch case as consequence of optimism bias, opposite is found in the Italian case. Pessimism about the usefulness of risk preparedness actions mainly prevented that activities were undertaken. I argue that this finding can be seen more as a socio-cultural than a socio-economical dimension. In addition, institutional complexity and fragmentation of organizations resulted in a low social trust in risk managers and the risk governance network in the Netherlands, resulting in even slower and more complex decisions (see Chapter 7). Also, since all the actors are related and dependent on each other, they tend to follow decisions by others. The implementation of policy measures for damage recovery takes long, and stimulated underpreparedness.

A low social trust in risk managers is also found in the Italian case as result of bureaucracy. This leading to underpreparedness in the institutional dimension played a critical role according to network actors. The results also show some similarities, for example both deal with myoptia bias, which is a the short-term vision of policy and politics.

As mentioned in 8.1.3., governance network actors indicated that they face difficulties to systematically bring their issues and interests to the attention of the journalists. However, media do have an important role in early warnings of a risk (Chapters 5, 6 and 7), because they can ´alarm´ network actors in an early stage. In Chapter 7 actors mention that media therefore can increase the awareness in the case of emerging risk.

In sum, different factors of underpreparedness in risk governance networks are present in the two cases, partly explained by the nature of the risk (emerging risk as consequence technology-induced activities

versus disruptive risk caused by natural processes). In the Dutch case, optimism bias and institutional complexity/fragmentation were key factors in underpreparedness. In the Italian case, bureaucracy and pessimism leading to low social trust and amnesia bias were the main factors in underpreparedness. In both cases, myoptia – short-term vision - bias affected the risk preparedness.

Connecting the findings with the theoretical background presented in chapter 2: Risk – Policy

In this thesis, I add to the study of Meyer and Kunreuter's (2017) that differences in the nature of the risk (emerging risk as result of human-activity or disruptive risk as result of natural process) are important in the explanation of underpreparedness on a network level. The findings of chapter 7 are in line with Fjaeran and Aven (2019) that risk managers could either not adopt a risk or take action to attenuate risk. However the thesis show in more detail that *optimism* bias is part of the cause of not taking risk prevention measures. While the *myopia* bias prohibited risk managers to develop a long term strategy for the risks and benefits. In addition, the thesis add to the literature that organizational complexity and *inertia* bias can delay risk prevention and mitigate actions. Thus, in both cases Meyer and Kunreater's (2017) phychological hinder biases resulted in policy stability in the light of punctuated equilibrium by Baumgartner and Jones (2009). The temporal catastrophic events did not substantially change the risk politics and risk governance.

8.2. Overall conclusion

In this paragraph I draw six conclusions (8.2.1) and answer the main research question (8.2.2.).

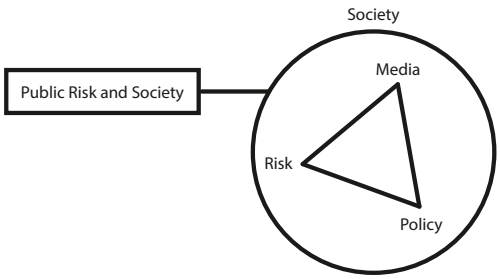


Figure 8.1: Public risk and society

8.2.1. This thesis

This thesis started with two quotes of journalists critically reflecting on the preparedness of risk governance regarding the Dutch and Italian earthquake risk. One journalist stated: "*How the hell could it get that far?"* for the Dutch earthquake case (AD, 2017). Another mentioned that there were "*...problems with mismanagement, political wrangling, stifling bureaucracy and corruption*" (The Guardian, 2019) in the Italian case. Both journalists address issues about the preparedness of risk governance networks for predictable earthquakes in the two countries, one addressing the lack of taking actions to prevent risk events, the other focusing on mitigating the adverse consequences of events. In this thesis I studied *how 'it could get that far'* - as one journalist stated – I also address the role of the media as essential factor in the social construction and governance of the risk. Consequently, I pay attention to the consequences of a lack of media attention for risk policy and politics. Based on the five empirical chapters I draw six main conclusions:

1. No key event – low media attention – low-risk preparedness

In Italy, news media immediately reported about the catastrophic earthquakes. Before and soon after the catastrophe, minimal attention is given by the media to the predicted risk. Similarly for the Dutch case, before the 2012 earthquake, the risk was hardly covered in the Dutch newspapers. The lack of attention in the newspapers did not stimulate the preparedness of risk governance actors in both countries. Biases such as myopia, amnesia, optimism/pessimism, and inertia undermined the technical, economic, social, and organizational preparedness. But the same biases also caused that media did not focus on the emerging risk, and consequently did not activate the risk governance network. When media attention does not create essential 'ripples' that stimulate actors to overcome these biases, also other governance actors are un(der)prepared. Key events are essential for the social construction of risk and to activate risk governance networks.

The earthquakes in Italy were catastrophic and caused disruptive changes for the economy, infrastructure, and social life of citizens. The catastrophic risk event was immediately newsworthy and served as a key event for the media to socially construct the risk for the local community and the country at large. However, in this thesis I also show that in the case of slowly emerging risk in the Dutch case the increases of frequency and magnitude of earthquakes is not always sufficient to socially construct the risk at a national scale. For the media,

the newsworthiness of the risk remains low when no key events can be identified. I further show that classifying a situation as something that puts the safety of citizens at stake also contributes to the social construction of the risk. Classification of an issue makes it easy to understand, and prone for media to be used as a key event, even in the case the realistic risk is limited.

2. Key events that trigger media hypes are not always tipping points for media content

In The Netherlands, the emerging realistic risk of earthquakes combined with the classification of 'high risk' in 2013, caused a media hype in the following years. A tipping point of the media content chaperoned the volume expansion. The disjoint change of both the use of sub-topics and sentiments was not temporary but persisted for years. From a technical issue, the gas-drilling and its adverse consequences became a controversial issue for Dutch society. In Italy, the media hype of reporting right after the catastrophe faded. It seems that the social risk of the catastrophes decreased, thus bringing the issue 'back to baseline' attention in the media and society.

3. Tipping points in the media are agenda-setters for politics but not necessarily for policies

I conclude that amplification or attenuation processes are not determined by the realistic risk event but by the social construction of the risk. When media only mediate technical messages about mild risks, the prominence of the risk may be attenuated, and 'ripples' towards the political agendas are negligible. However, in contrast to the strong effect on the Dutch political agenda, I cannot find proof for an agenda setting role of media on the policy agenda of State Supervision of the Mines (documents). On the contrary, a risk signal from SodM was necessary for the media, since new meaningful information was provided by SodM, which enabled media to reframe the issue. SodM information was amplified by media, which resulted in agenda setting in the political arena. Of course, it was not a simple linear process. The SodM reporting and risk classification was also directly noticed by the politicians, who on their turn may have become sources of information for media. Mediatized risk is vital for the social construction of risk and creates 'ripples' in society. It affects the political agenda, but not necessarily the administrative policy agenda.

4. Media logic is vital for risk governance but has its drawbacks

In the construction of the news, media apply media logic through frames, sentiments, and biases, which help to make issues salient for laypeople and politicians. This media logic can also create social amplification and result in responses of actors involved in risk governance. I show that media add dramatization biases and apply emotion-loaded content only when meaningful information about a risk issue becomes available. Meaningfulness for media seems to be dominated by newsworthiness, as emotional and dramatization loaded sub-topics like safety, feelings, and disadvantage position of certain local groups. Furthermore, since newsworthiness aligns with media logic, key events can generate a media hype with a pack of journalism as the outcome (more news media, expansion of volume). For the Dutch earthquakes, I show that there is a strong relationship between the media content and the political agenda. Therefore, I conclude that applying media logic to risk issues has a direct effect on the mediatization of the political agenda, and therefore mediatized news plays an essential role in society. However, the media seems to have a short-term focus as is visible in the Italian case where the aftermath of the catastrophes do not seem newsworthy enough for the Italian media. Even though the catastrophic earthquakes in Italy immediately generated a lot of media attention, this did not result in mediatized risk policy changes in the long run. So, media logic serves as significant filter for the attenuation or amplification of risk in society and influences risk governance action and preparedness. Media logic stimulates amplification and risk governance action in politics. However, when vital risk information does not align with media logics, a risk may attenuate significant adverse consequences for communities and society at large and taking long-term decisions may be discouraged.

5. Risk governance actors can make better use of media when they are familiar with media logic

Mediated news is essential for spreading information about risk. In this thesis, I show that in both the Italian and Dutch cases, that media can play a role as agenda-setter and strategic instrument but mainly play a role as a democratic forum. The democratic forum role of the media basically can lead to short term attention and decisions. This short term attention can also harm the decision making process and consecutively the risk preparedness of the network, since the pressure to take actions without analysing the consequences is possible. But risk

governance actors also mention that a more dominant agenda-setter role of the media in the construction of the risk could help them to take earlier actions to reduce the impact of the risk. Journalists should thus be enabled to add news value to risk information to make it salient for broader audiences, including politicians. The risk information can be received from risk governance actors, but it should not only contain technical descriptions, but also contain newsworthy elements that allow the application of media logic. In this thesis, I show an example of the initiation of the social construction of the risk ('It is high risk and thus a safety issue') by risk experts from a governmental organization: the supervision authority State Supervision of the Mines(SodM). Their norm-setting after the happening of a real risk event (Huizinge earthquake) was the key event for media. It functioned as the starting point of the amplification of risk. Actors within the risk governance network can provide meaningful information for media to frame or reframe the coverage of the item in a strategic way and serve as agenda-setter in politics in the long run. When risk governance actors can provide risk information that aligns with media logic, media can mediatize this information and play a better role as an agenda-setter. However, in such situations, risk governance actors need to overcome a herding bias (Meyer and Kunreuter, 2017) to escape from the technical subdomain (Baumgartner and Jones, 2009) which may contribute to inertia in policy making.

8.2.2. Answering the main research question

These six main conclusions are the foundation of my answer to the main research question of this thesis:

> ***How and when do media play a role in the social construction of a risk issue, what is its influence on risk governance processes of emerging technology-induced earthquakes and natural earthquakes?***

News media do not extensively cover technology-induced risks such as mild earthquakes, or the risk of future catastrophic earthquakes. Generally, the newsworthiness of the topic is low when only information from technical sub-domains is available that can be mediated to the public. In the absence of visible, easy-to-recognize events, techno-scientific risk information does not align with media logic to satisfy broad audiences. The consequence of low media attention is

low-risk awareness among network actors. Low awareness and media attention also do not stimulate risk governance actors and politicians to organize processes to prevent or mitigate future risk events and their adverse consequences. When media attention is low, it can even result in underpreparedness of the risk governance network for risk events. Although media do not carry responsibility for risk preparedness activities, media may help to overcome: the short term focus, to learn from previous events, to become realistic about the impact of risk governance activities, to address responsibilities in risk governance, and to reduce organizational complexity and bureaucracy.

Significant earthquakes can rapidly change the media attention when they have substantial adverse consequences for society. However, catastrophic events seem to be mainly mediated to the public. *'The brute reality of the physical consequences'* dominates the news, as stated by Busby and Duckett (2012, p. 1066). Nevertheless, the newsworthiness of the risk can fade rapidly after the event. Consecutively also the pressure on politicians and risk governance actors can rapidly fade, returning to normal. A decline of media attention causes a status quo in policymaking even when it is temporarily disturbed. Comparable to Down's issue Attention Cycle, media and public attention can be driving forces behind agenda setting.

To change the political agenda and to stimulate risk governance networks, temporal volume expansion of media is thus not sufficient. A change in the content of news media reporting is required to allow media to play a role as an agenda-setter. Besides, the volume expansion should last for an extended period and the content needs to make the issue more controversial in society. The content should address frame elements of controversy for society, such as decision making, responsibility, conflict, and human interest. According to Kingdon (1995), interest groups help politicians to understand public preferences and seize a moment for policy change. Baumgartner and Jones (2009) hypothesize that this can be a disjoint change, and that is what I found in the gas drilling policy in The Netherlands. Media helped to 'stream' the problem of earthquake risk, policy warning by Supervision authority State of Mines, and political willingness to focus on the issue. A 'window of opportunity' was created for a change in risk governance of the emerging earthquake.

Media – Risk – Policy

In this thesis, I show that when technology, such as gas drilling, is embedded in a subsystem framework of legislative measures, signals of changes in risk assessment may not raise awareness among politicians (Baumgartner and Jones, 2009). Those changes may not be noticed as incongruent information to reframe the issue and political attention will mainly be focused on the *beneficial* effects of the gas drilling. Policy actors can neglect early warnings of risk for long periods. As Kingdon (1995, p. 128) argued: *"Problems that have no solution attached to them are less likely to make it into governmental decision agendas"*. Alternatively, as Down's argued, a lack of understanding, cynicism, and unwillingness to sacrifice (the benefits of gas revenues) caused a lack of salience and enthusiasm to limit gas drilling as an option to prevent earthquakes.

After media coverage returns to low levels, the repetitive nature of the risk will be neglected by the media. Actually, media also seem to suffering from myopia, amnesia and herding biases, while during attention expansion, myopia, negativism (as opposed to positivism), and simplification biases are manifested. The study thus adds support to the literature that attenuation occurs (in the long run) as a result of a lack or low coverage in the media when the newsworthiness of a risk event is limited. So, I conclude that event-driven media attention for risk tends to follow Down's Issue Attention Cycle when media mainly fulfil a role as a democratic forum and that the strategic and agenda setting roles of media are limited.

In this thesis, I argue that the Social Amplification of Risk Framework captures the dynamic interaction between risk, media, and policy. The authors of SARF argued that media play a vital role in the social amplification (or attenuation) of risk. However, their representation of the media's role has already, from the beginning, been critiqued as being overly obsolete and too straightforward (Rip, 1988, Raynar, 1988). Binder et al (2015) furthered the role of media in SARF but concluded that longitudinal studies are required about the role of media in the social amplification and also the attenuation of risk. In my thesis, I accepted this challenge. Many studies showed the amplification role of media. What this study adds to this existing literature is detailed insights in the changing role of the media in the coverage of earthquake risk over the span of 25 years, where both attenuation and amplification of risk are visible. Furthermore, earthquake risk is studied in two different cases, where the nature of the risk differed, the governance

networks differed and therefore the role of the media differed. Both the longitudinal study and the case comparisons add knowledge to existing literature about the interactions between the nature of the risk, the role of the media, and policy and political action. The in-depth interviews with risk governance actors provides new insights on the impact of media on risk governance networks that was currently lacking in literature. Media have a paradoxical impact on risk governance networks. It is not a novelty in today's literature that media influence decision making networks (e.g., Entman, 2007; Cook, 2005; Stömbäck & Nord, 2006), and that they have an agenda-setter role (e.g., Elder & Cobb, 1983; Baumgartner & Jones, 2009; Van Aelst & Walgrave, 2011).

With this thesis, I add that governance actors try to make use of strategic and agenda setting roles of media, although do not always succeed in this. But in an early stage of an emerging risk media can have a important agenda setting role since they are a station that socially construct an event or situation and transmit messages towards the society. Therefore the role of media is important for governance network actors to gain awareness, overcome governance biases and become more prepared. In contrast, sensational and dramatic elements in media reporting on risk governance may also have negative consequences, and this receives relatively little attention . The application of media logics with full focus on satisfying their consumers limits the agenda setting function of media to short-term political agendas. It hardly reaches direct long-term policy agendas or policy implementation. Media logics may even result in exaggerated attitudes in society and hyper-reaction in the political arena to future risk. It is in full alignment with the words of former Dutch politician *Alexander Pechtold*:

> *"The hyper-reactions between media reports and our (political) agenda hold us in the present and obstructs our responsibility for the longer term".*

8.3. Limitations of the study and reflection on machine learning as research technique

Of course, this study has multiple limitations. Comparing two cases of earthquake risk with different origins, different frequencies and magnitudes, in two countries with different cultural and socio-economic backgrounds, and many other different elements, does not

easily lead to conclusions that can be generalized. The main risk case focused on the dynamics in the interaction and attention at subtopic level by media and politics is situated in Groningen, The Netherlands. The strong influence of media attention on political debates may, according to Vliegenthart and colleagues (2016), partly result from the Dutch multiparty democracy system. Such a bias may be strong in this particular case, because when media attention expanded rapidly a political election took place. Although not further studied, the parties' political campaigns were influenced by the gas drilling case. The political situation in Italy is different, as well as the interaction between media and administrative policy and politics. In this thesis it was not possible to make a full comparison between the two cases at content level of newspaper reporting.

The focus of the study is on newspapers. This obviously is a serious limitation, as other traditional media like radio and television play an important role in agenda setting. In addition, social media are not taken into account, although in the first period under study this limitation may be unimportant. In the period after 2000 and particularly after 2012, social media may have seriously influenced political debates and may also have stimulated media to start reporting about safety and threat. An issue subtopic that was not extracted by SML from newspapers and political debates was *health*. Although this was not further investigated, I have the impression that this subtopic, and particularly *mental health*, might have been important among citizens and in social media.

An important limitation of the study is that for the gas drilling case in The Netherlands I have not investigated the role of SodM and the ministry of Economic Affairs separately. As is indicated by Dutch Safety Board (OVV) (In Dutch: Onderzoeksraad voor Veiligheid), SodM was committed for an extended period to the network of actors responsible for the gas drilling policy. In the network, coordinated by Maatschappij Groningen, the Ministry of Economic Affairs, SodM, Energie Beheer Nederland, Shell, Exxon Mobile and Gas Terra participated and collaborated. OVV classified it as a stronghold (In Dutch: 'bolwerk') and it has all characteristics of a technical subdomain as stated by Baumgartner and Jones (2009)

I believe, however, that this case study contributes to elucidating the complex and relatively unstructured phenomenon of media-destabilised risk policies. In accordance with Howarth (2013), I underscore the need for more empirical case studies on the interaction between

risk, media, and policy, focusing on different risk policies and within different countries and contexts. Using the content of newspapers and transcripts of political debates about risks and benefits of gas drilling and earthquakes in The Netherlands generated large databases that could be successfully analysed by SML. The Dutch language, which has its difficulties for SML (Boiy & Moens, 2009), was not a fundamental problem in the study. The quality of the results in terms of variability, recall, and precision cannot be assessed however. For human coding, there are intercoder variability guidelines, but machine learning still lacks comparable guidelines. The set of 105 transcripts of parliamentary debates was sufficiently large to apply SML, although the much larger dataset of newspaper articles gave better precision and recall results. The study also illustrated that large datasets are required to train the machine algorithms, as the smaller database of the regulatory authority's 25 annual reports was not large enough to do so. A clear guideline for the cut-off is not available and may be dependent on the nature of the data. Smaller datasets still require manual coding, but human coding is also required on a training set to train the computer algorithm. Machine learning produces consistent subtopics that do not shift over the course of annotating. Therefore, SML was suitable for the longitudinal analysis of content. The downside, however, is that the data need to be consistent. The algorithm 'learns' by looking at word occurrences, so if the word usage suddenly changes – for example because data from a very different source are used – the algorithm will not perform as well as it would for a homogeneous dataset. The Dutch language usage in the datasets of newspaper articles and parliamentary debates probably differs because they serve different objectives and audiences. This may help to explain the (limited) differences in recall and precision in the datasets of media articles and political debates. In spite of this limitation, subtopics extracted from newspaper articles showed clear correlations with political transcripts.

8.4. Practical implications

The network actors can initiate media attention, contributing to awareness and agenda setting in policy and politics. When risk governance actors strategically use the media and pre-frame information that is appealing and aligns with the media logic, the media are enabled to play their democratic role as watchdog and agenda-setter. Governmental

agencies and other stakeholders involved in risk governance should take strategic action when they need media to raise public and political awareness for a risk issue. This strategic action should include a media strategy in which the risk governance network actors pre-frame content of the issue in a manner that is aligned with media professional rules to enable journalists to bring the message to broader audiences.

Risk managers, politicians, companies and also citizens need to be aware that media easily trigger on risk signals with high visibility. When needed, pre-framing information which is newsworthy can be a fruitful strategy for risk governance actors. However, these actors should also take into account that a signal of small risk which has high visibility is equally interesting for news media. Small signals can be amplified by media logics, and ultimately lead to pressure on risk managers to take action, even when these actions are ineffective or even counterproductive. Therefor risk governance actors should be careful with communication about risk signals which may be prone to social amplification.

Governance network actors should be aware of potential decision biases, which contribute to technical, social, economic, and institutional underpreparedness. Knowing that these decision biases exist and discussing the potential of getting influenced by one or more of these biases can aid the preparedness for future risk events. However, the interplay between the role of the media and the role of governance network actors themselves in overcoming these biases has to be further studied in the future. In my thesis, I have shown that the media can influence the (under)preparedness of the governance network actors by addressing the risk event and its management publicly. The governance network actors can also play a role by inviting the media to take its role as watchdog or agenda-setter. Future research may elaborate on whether (under)preparedness should be a responsibility of the governance network actors or the media and how long-term decision making is encouraged in both.

Amplification of risk signals is also relevant in other domains, particularly when risk signals are available with high visibility. Below, I provide a simple example of a situation in which media mainly mediate pre-framed information from an expert institute. In several areas of governmental action, 'traffic lights' are introduced during the last decade. The Royal Dutch Meteorological Institute (KNMI) for instance uses traffic light as warning signals for bad weather. Media hardly report about the backgrounds of such traffic lights. This is no surprise since

the newsworthiness of such technical information is low. However, when the weather forecast of KNMI is 'red' media attention is generated since it is such an easy to understand signal can be communicated to broader audiences. However, 'red' warnings may also be exaggerated by media causing overresponses in society, which in turn may lead to critiques on the (weather) risk assessors.

Finally, a practical note for social researchers in the field of content analysis. Scharkow (2013, p. 762) argued that '*Supervised text classification, which uses superficial statistical algorithms from machine learning, has the potential to become a standard method for quantitative content analysis*'. But applying SML in social science research is still in its exploratory phase. In this thesis I showed that, in spite of the ongoing development of the learning methodologies, SML can already successfully be applied in longitudinal studies with content from different sources, produced by different outlets. However, I recommend to focus research on the capabilities and limitations of SML, its practical application and developing guidelines for application. When taking the capabilities and limitations of SML and human-coding in consideration, SML proves to be a better methodology for analysing large datasets because of its consistency and speed. I recommend SML to replace human coding as the new 'standard methodology' for content analysis of journalism-, media-, and political studies of large data bases.

8.5. Future research agenda

In this thesis, the cases are studied by analysing newspapers, policy and political documents, and interviewing governance network actors. While these sources provide a good picture of the reactions of media, politics and policy to risk events, future research should focus on other important sources. Interviewing journalists or other news providers could provide more insights in the perception of media actors. Another important source for future research is online and social media, with a growing amount of messages and news sharing online, the communication about risk and the key risk events media report about can be followed (almost) real-time and opinions and actions of politicians and policymakers can be followed online. Incorporating those sources in future research on risk events and politics-policy-media interaction can help us further understand the dynamics in those relationships.

The use of SML is still not widespread, while it proves to be an effective and consistent tool for studying large datasets. Future research can focus on the improvement of the algorithms, studying the most effective way of human-coding the test set for SML in order to let the machine learn faster and perform better on precision and recall. Using SML for coding large datasets in which language plays an important role in future research can help make it a more standard method in social sciences.

The interaction between media, politics, policy and risk is studied here in two different European countries. In our study, we found that the dynamics between media, politics and policy regarding risk differ for the two countries. This indicates that to fully understand the dynamics, it is important to study it for different (Non-European) countries and other cases with other types of risk. I suggest that future research should look into the interplay between media, politics and policy in other countries that face similar risk events. Furthermore, comparing the reactions of media, politics and policy in different types of risk events within the same country can further extend our knowledge on the dynamics and the characteristics of risk in society that lead to attenuation or amplification of the risk.

Nederlandse Samenvatting

"*Geachte Voorzitter,*
De gaswinning uit het Groningerveld wordt op zo kort mogelijke termijn volledig beëindigd. Die inzet is naar de opvatting van het kabinet de beste manier om de veiligheid en de veiligheidsbeleving in Groningen te garanderen."

Dit is de openingszin van de brief die het kabinet op 29 maart 2018 aan de Tweede Kamer stuurde. Niet omdat het gas 'op' is, want de reserve anno 2020 is nog ongeveer 60 miljard euro waard en daarvan zal het overgrote deel ook na 2031 nog aanwezig zijn in de Groningse ondergrond als het boren gestopt moet zijn, maar omdat de 'veiligheid en de veiligheidsbeleving van burgers' daarom vraagt volgens de regering. In de Kamerbrief schrijft het kabinet veel verder te gaan in de maatregelen dan het Staatstoezicht op de Mijnen (SodM) adviseert. En het kabinet gaat ook veel verder dan de aanbevelingen die de Onderzoeksraad voor Veiligheid (OVV) deed op 18 februari 2015.

"Het wordt tijd om de oorzaak van de aardbevingsrisico's weg te nemen" schrijft het kabinet in 2018. In deze thesis volg ik de risico definitie van Rosa (1998, p. 28): 'een situatie of gebeurtenis waar iets van waarde voor mensen op het spel staat, en waarbij de uitkomst onzeker is'. De vraagt rijst dan: wat is er dan veranderd aan 'de situatie'? Zijn de fysieke veiligheidsrisico's door de gaswinning opeens sterk toegenomen? Daarop is het antwoord eenduidig 'nee' zoals uit de rapportages van SodM blijkt (www.SodM.nl/sectoren/gaswinning-groningen). De sterkste geregistreerde aardbeving in Groningen was – en is op het moment van schrijven van deze thesis – die van 16 augustus 2012 in Huizinge, die voor het OVV de directe aanleiding gaf om haar onderzoek te starten. Blijkbaar was in 2013 en 2014 een bedreiging van "veiligheid" nog onvoldoende motief voor het kabinet om maatregelen te nemen om aardbevingsrisico's te beperken. Sterker nog, in deze jaren mochten gasproducenten juist meer gas winnen dan in 2012.

De kern van het kabinetsbesluit lijkt dus gebaseerd op de "veiligheidsbeleving" van aardbevingsrisico's van burgers. Hoe die risico's worden ervaren, wordt bepaald door subjectieve gevoelens over bepaalde situaties of gebeurtenissen (Slovic, 2000). Maar was de veiligheidsbeleving van burgers dan zoveel veranderd? Niet voor de naar schatting 200.000 mensen die in het Groninger aardebevingsgebied wonen of werken; zij ervaren al vele jaren aardbevingen. Maar misschien was de

veiligheidsbeleving in de rest van Nederland wel veranderd, en daarmee samenhangend de bereidheid van de politiek om de baten en risico's van gaswinning opnieuw af te wegen.

In dit proefschrift onderzoek ik de governance van risico in het media-tijdperk en maak ik specifiek gebruik van krantenartikelen om de ontwikkeling in veiligheidsbeleving te traceren door hoe kranten verslag doen van aardbevingsrisico's, hun oorzaken en gevolgen. Daarbij neem ik aan dat aandacht voor een bepaald onderwerp in kranten een weerspiegeling is van bredere aandacht voor dat onderwerp in andere nieuwsmedia.

In dit onderzoek richt ik mij vooral op de wijze waarop burgers, overheid en politici geïnformeerd worden door media; en dan vooral gedurende de periodes voor en na de Huizinge aardbeving in 2012. De aardbevingen in Groningen worden als risico-case gekenmerkt door het langzaam toenemende risico als gevolg van een door mensen geïnitieerde technologische activiteit (gaswinning).

Om het te verwerven inzicht over risico, governance en media niet alleen te baseren op de Nederlandse situatie, heb ik een vergelijkende studie gedaan naar aardbevingsrisico's in Italië. In het centrale deel van de Apennijnen werd L'Aquila in 2009 getroffen door een serie zware aardbevingen en in 2016 het 100 km noordelijker gelegen Norcia eveneens. De aardbevingen waren veel zwaarder dan die in Groningen, richtten veel schade aan waarbij ook dodelijke slachtoffers vielen. Zij hadden een natuurlijke oorzaak en waren dus niet het gevolg van technologische activiteiten. Bovendien vonden ze plaats in een geheel andere sociaal economische, culturele en media context. De casus van Italië verschilt sterk van de Nederlandse en dit helpt de analyse te verrijken en te verbreden voor de beantwoording van de hoofdvraag van dit proefschrift:

> **Hoe en wanneer spelen media een rol bij de sociale constructie van een risico, wat is de invloed ervan op governance van risico van opkomende door technologie veroorzaakte aardbevingen en natuurlijke aardbevingen?**

De verspreiding van risico informatie door de media

Veiligheid voor burgers en maatschappelijke organisaties is geen vanzelfsprekendheid. Om veiligheid te borgen moeten risico's in het publieke domein op de een of andere manier beheerst worden. Risicobeheersing kost de samenleving geld en verlangt maatschappelijke keuzes.

Voor vrijwel alle risico's vereist dit een samenspel van verantwoordelijken in de politiek, in overheidsbeleid, bij maatschappelijke organisaties en burgers. Netwerk governance (Koppenjan & Klijn, 2004) heeft op brede schaal zijn intrede gedaan en voor veel specifieke veiligheidsissues zijn veelal netwerken ontstaan van publieke en maatschappelijke organisaties die risico's proberen te voorkomen, te beheersen of de schadelijke gevolgen te beperken (Klinke & Renn, 2019).

Media hebben een belangrijke rol in het verspreiden van informatie over veiligheidsrisico's in de samenleving, die al dan niet veroorzaakt worden door technische publieke activiteiten zoals gaswinning. Zonder media zal een groot deel van de bevolking geen of weinig besef hebben van risico's die zij niet zelf direct ervaren (McCombs, 2004). Media spelen daardoor een cruciale rol in het verspreiden van informatie en opinies over risico's (Finucane et al., 2000). De wetenschappelijke literatuur leert ons twee belangrijke zaken over het verspreiden van risico – informatie door de media:

(1) media maken zelf een selectie van wat zij nieuwswaardig vinden. Het kan zijn dat media er bijvoorbeeld voor kiezen om juist niet te rapporteren over een publieke kwestie of in de berichtgeving simpelweg doorgeven welke informatie zij van andere bronnen hebben ontvangen.
(2) media verspreiden de informatie vaak niet neutraal. Zij gebruiken hun eigen professionele aannames en processen om berichten te produceren. Zij gebruiken specifieke sentimenten in hun rapportages, benadrukken sommige elementen van een issue (emphasis frames) en zetten andere technieken in waarvan zij denken dat die interessant zijn voor hun publiek (Altheide & Snow, 1979, Bennett, 2009). Deze medialogica heeft invloed op de wijze waarop de samenleving geïnformeerd wordt over een bepaalde risicovolle situatie of gebeurtenis. Hoe media rapporteren en wanneer ze dat wel of niet doen, heeft potentieel invloed op hoe en wanneer actie wordt ondernomen in politiek en beleid en door andere maatschappelijke actoren om tot risicobeheersing te komen.

Een belangrijk raamwerk die in dit proefschrift (hoofdstuk 2) wordt gebruikt om risico's en de governance van risico's inzichtelijk te maken, is het Social Amplification of Risk Framework, kortweg SARF (Kasperson et al., 1988). Dit raamwerk helpt om beter grip te hebben

op de maatschappelijke impact van risico-informatie. Het raamwerk is oorspronkelijk ontwikkeld om te beschrijven hoe sommige situaties of events die door experts als een klein risico worden beoordeeld, massale aandacht krijgen van de samenleving (bijvoorbeeld terrorisme). In dit geval worden signalen van een mogelijk risico versterkt (geamplificeerd) door nieuwsmedia en andere partijen, doordat aan de berichten subjectieve elementen toe worden gevoegd die de risicobeleving versterken. Het tegenovergesteld is ook mogelijk: een situatie of gebeurtenis die als hoog risico wordt beoordeeld krijgt weinig tot geen aandacht van de samenleving (bijvoorbeeld tabaksgebruik). Dit proces wordt attenueren (verzwakken) genoemd. Zowel amplificatie, als attenuatie heeft volgens het raamwerk invloed op andere delen in de samenleving zoals de economie. Op basis van een metafoor over een steen die in het water valt en rimpelingen in het water veroorzaakt, zijn het volgens de auteurs van SARF de 'rimpelingen' die zich door de samenleving ('het water') verspreiden en andere delen van de maatschappij beïnvloeden. Geattenueerde risico's bereiken soms de politieke agenda niet omdat de rimpelingen al zijn uitgedoofd voordat zij de politieke arena bereiken. De consequentie is mogelijk dat er geen tijdige veiligheidsvoorzorgsmaatregelen worden genomen of beleid wordt gemaakt. Anderzijds kunnen kleine risico's, die sterk geamplificeerd zijn tot grote rimpelingen in de samenleving, resulteren in ferme politieke besluiten en grootschalige en kostbare maatregelen.

Terwijl dit raamwerk een van de weinige conceptuele raamwerken is waarin het gehele proces van de impact van risico-informatie op de samenleving wordt beschreven, is er ook wetenschappelijke kritiek op dit raamwerk. Rip (1988) en Rayner (1988) vinden dat het raamwerk onvoldoende duidelijk is over wanneer - en wanneer niet - een bepaalde situatie of gebeurtenis leidt tot disproportionele aandacht in de samenleving. Onduidelijk is bijvoorbeeld welke rol media en medialogica hebben bij het ontstaan en de amplificatie of attenuatie van de rimpelingen in de maatschappij. En daarnaast is het volgens de critici onduidelijk welke effecten deze hebben op bijvoorbeeld de governance van risico's. De kritiek op het raamwerk sluit aan bij de behoefte van andere wetenschappers die stellen dat media-, politieke en beleidsinteracties nog onvoldoende zijn bestudeerd (Howarth, 2013; Wardman and Lofstädt, 2018). En met name over de rol van media bij de sociale constructie van een risico, en de doorwerking in maatregelen om de risico's te beheersen, bestaat nog veel onduidelijkheid in de literatuur.

Media kunnen governance netwerken stimuleren tot actie door veel aandacht te geven aan een veiligheidsissue door bijvoorbeeld in een vroeg stadium te waarschuwen voor een opkomend (of nieuw) risico. Evenzeer zou media governance netwerk actoren kunnen bekritiseren. Idealiter kunnen netwerken tijdig veiligheidsmaatregelen ontwikkelen en kunnen democratische beslissingen in de politieke besluitvormingsprocessen afgewogen worden genomen, als media zijn waakhond functie invult. Aan de andere kant kunnen media de werkzaamheden van governance netwerken hinderen doordat ze niet - of niet tijdig - rapporteren of waarschuwen en daarmee burgers, overheid en politici minder informatie verschaffen dan zij nodig hebben. En ook kunnen zij door hun beoordeling van nieuwswaardigheid en toepassing van medialogica een beeld creëren van de risico's dat niet overeenkomt met schattingen van experts (Binder et al., 2015). Hierdoor kunnen maatregelen en besluiten worden genomen die niet-proportioneel zijn met de wetenschappelijk vastgestelde risico's.

Over de media-, politieke en beleidsinteracties rondom risico's, in het bijzonder aardbevingsrisico's, gaat deze studie. Voor de beantwoording van de hoofdvraag van dit proefschrift heb ik enerzijds met behulp van Supervised Machine Learning techniek een media sentiment en een media content analyse uitgevoerd op basis van 2665 Nederlandse krantenartikelen over de aardbevingen in Groningen. Deze content- analyse is vergeleken met een content analyse op parlementaire documenten en jaarverslagen van het Staatstoezicht op de Mijnen. Daarnaast heb ik semi-gestructureerde interviews gehouden met vertegenwoordigers van maatschappelijke en publieke organisaties die actief zijn in veiligheidsnetwerken in zowel Italië en Nederland.

Belangrijkste bevindingen van dit proefschrift

1. Media spelen een belangrijke rol in de samenleving

In de eerste deelvraag van het proefschrift ga ik in op de vraag: wanneer en hoe framen en herframen media een toenemend risico in de loop van de tijd?

In hoofdstuk 6 laat ik zien dat actoren uit het risico-governance netwerk vinden dat media een belangrijke rol speelt in de governance van risico's in een democratische samenleving. Wanneer er grote ontwrichtende gebeurtenissen met veel schade, zoals de zware Italiaanse aardbevingen, plaatsvinden, verspreidt de media direct risico-berichten. Maar de Italiaanse respondenten geven ook aan dat deze aandacht

snel na de gebeurtenissen afneemt. De disruptieve gebeurtenissen op zichzelf genomen waren dus nieuwswaardig voor media, maar de lange termijn gevolgen en herstelwerkzaamheden zijn dit niet.

De hoofdstukken 3 en 4 laten zien dat wanneer ontwrichtende gebeurtenissen voor (een deel van) de samenleving ontbreken, kranten zeer weinig aandacht hebben voor aardbevingen. Zelfs als de aardbevingen veroorzaakt worden door menselijk handelen en optreden in een gebied dat geen geschiedenis heeft met dergelijke risico's, zoals de provincie Groningen. Het fysieke aardbevingsrisico, dat toenam (frequentie en magnitude) gedurende een periode van meer dan 20 jaar, zorgde slechts voor een lichte stijging van het aantal mediaberichten. Regionale kranten rondom het risicogebied rapporteren eerder en vaker over de risico-situatie dan nationale kranten. Nabijheid ten opzichte van de bron van het risico is een factor voor mediaberichtgeving.

Hoewel de aardbeving in Huizinge op augustus 2012 voor relatief veel schade in de omgeving zorgde, was deze gebeurtenis opvallend genoeg niet direct aanleiding voor een toename van het aantal mediaberichten. De gebeurtenis was niet ontwrichtend genoeg blijkbaar, al was het wel een indicator dat er een risicovolle situatie was. De omslag in het aantal berichten in Nederland vindt enkele maanden later plaats. Dat de mediaberichtgeving begin 2013 'ontplofte' is niet te verklaren op basis van de frequentie en magnitude van de bevingen. Een andere factor is doorslaggevend voor de media om te gaan rapporteren. Het was vooral het rapport van januari 2013 van het Staatstoezicht op de Mijnen van dat zorgde voor de omslag in de berichtgeving in kranten. SodM adviseerde de regering maatregelen te nemen om de gaswinning te beperken omdat de gasboring een hoog risico bleken te zijn voor de woonomgeving van burgers en meer en grotere aardbevingen in de toekomst plaats zouden kunnen vinden. De classificatie van het risico als 'hoog' door SodM was een helder doorslaggevend signaal, dat in lijn met eerdere publicaties van Vasterman (2018), en Kepplinger & Habermeier (1995) door media benut kan worden voor expansie van berichtgeving.

In hoofdstuk 4 laat ik zien dat in de periode van weinig media-aandacht voor het risico vooral technische informatie domineert in de berichtgeving van kranten. Ook is er een sterke focus op de opbrengsten van de gaswinning en wordt er weinig geschreven over eventuele risico's en de gevolgen ervan. Maar ten tijde van de omslag in de media verandert de inhoud van de krantenartikelen abrupt. De media benoemen opeens dat door de aardbevingen de veiligheid van burgers in het

geding is. Ook schrijven ze over de vraag wie er verantwoordelijk is voor de aardbevingen, wie er belang heeft bij de gasboringen, wie de schadelijke effecten kunnen ondervinden en hoe burgers zich voelen die in het aardbevingsgebied leven. De verandering in aard van de krantenberichten naar aanleiding van het signaal van SodM is ook te vinden in hoofdstuk 3, waarin ik bestudeer welke biases en sentimenten media inzetten bij hun rapportages over de gaswinning en de risico's. Vanaf 2013 zetten media een scherpe waardentegenstelling neer, namelijk economische baten aan de ene kant en de veiligheid van burgers aan de andere kant. Tevens wordt het nieuws een stuk negatiever en worden de verhalen persoonlijker. Voor 2013 zijn deze dramatische aspecten veel minder aanwezig in de krantenberichten.

Uit de vergelijking van de Italiaanse en Nederlandse aardbevingssituaties komt het beeld naar voren dat ernstige catastrofale aardbevingen op zichzelf sterke signalen zijn voor media om intensief te rapporteren. Echter, deze fysieke signalen blijken maar korte tijd nieuwswaardig, en media-aandacht verslapt snel. Down's Issue Attention Cycle (1972) over snelle toe- en afname van media-, maatschappelijke en politieke aandacht voor een onderwerp, lijkt een kort cyclisch verloop te hebben als de samenleving verstoord wordt door een catastrofaal fysiek risico dat niet-controversieel is. Langzaam ontwikkelende risico's - zoals de aardbevingen in Nederland - zijn op zichzelf niet erg nieuwswaardig zolang de ontwrichting van de samenleving beperkt is bij iedere beving. De nieuwswaardigheid kan echter snel omslaan als het onderwerp controversieel wordt in de samenleving, de Issue Attention Cycle activeren. Zonder verandering van beleid kan een controversieel onderwerp lange tijd in de schijnwerpers van media blijven. Down's Issue Attention Cycle vertoont dus wel de snelle toename van media-, maatschappelijke en politieke aandacht, maar niet de afname daarvan. De cyclus wordt maar half doorlopen als een risico maatschappelijk controversieel wordt en feitelijk van onderwerp verandert.

2. Media en politiek beïnvloeden elkaar, toezicht volgt een eigen koers

De tweede deelvraag van het proefschrift luidt: wat is de dynamiek tussen media, politiek en beleidsagenda's?

In hun punctuated equilibrium theory beschrijven Baumgartner en Jones (2009) dat het vaak voorkomt dat binnen een bepaald beleidsterrein - zoals energiewinning - beleid en politiek lange tijd stabiel zijn. Maar zij geven ook aan dat deze stabiele periodes, waarin slechts kleine

aanpassingen en bijstellingen van beleid plaatsvinden, abrupt gevolgd kunnen worden een drastisch andere beleidskoers. Baumgartner en Jones (2009) beschrijven dat media daarbij een belangrijke rol speelt, maar onderzoeken die rol niet in detail. In hoofdstuk 5 laat ik zien dat de Nederlandse gaswinning een mooi onderzoeksonderwerp is om beter inzicht te krijgen in de dynamiek tussen media-aandacht en veranderingen in de beleidsontwikkeling en -uitvoering om risico's voor burgers te beperken of zelfs te voorkomen. Na bijna 60 jaar van stabiel gaswinningsbeleid komt vanaf 2013 plotseling sterke politiek druk om het beleid drastisch te veranderen. In vele jaren van stabiel beleid houdt nieuwsmedia zich in de luwte en berichten zij weinig over het risico, waardoor er geen aanleiding gegeven wordt voor beleidswijziging en daardoor blijft de status quo in de politiek en het beleid onaangetast (Bakir, 2010).

In hoofdstuk 5 onderzoek ik niet alleen de media agenda (krantenartikelen) maar ook de politieke agenda (transcripten van debatten in de Tweede Kamer) en de toezichtagenda (Jaarverslagen van de Staatstoezicht op de Mijnen) en bekijk de onderlinge dynamiek. Hierbij heb ik gekozen voor het analyseren van de agenda van toezicht, dat in de kaderstellende visie van het kabinet in 2005 als sluitstuk van de beleidscyclus wordt benoemd. Bovendien had SodM op het gebied van gaswinning sinds de start van de gaswinning een belangrijke rol bij de uitvoering van beleid (Onderzoeksraad voor Veiligheid, 2014). Mijn onderzoek laat zien dat de media agenda en de politieke agenda sterk met elkaar samenhangen, zowel in hoe vaak ze berichten over aardbevingen als de wijze waarop ze erover schrijven en spreken. Deze sterke samenhang tussen volume en inhoud van beide agenda's zie ik zowel in een periode van het weinig rapporteren (1990-2012) als in de periode van overvloedig rapporteren (2013-2015). Samenhang met de toezicht-rapportages is er vrijwel niet.

Maar waar media en politiek een sterk verband vertonen met de onderwerpen die ze benadrukken, is er geen verband gevonden met de agenda van SodM. Cobbs and Elder's (1983) agenda setting hypothese die stelt dat media de publieke agenda mede kunnen bepalen, is bij de Nederlandse aardbevingsrisico's wel terug te vinden voor de politieke agenda, maar niet of nauwelijks voor de toezichtagenda. De resultaten laten feitelijk zien dat het herdefiniëren in de situatie op de toezichtagenda (SodM: aardbevingen = veiligheidsprobleem) doorslaggevend is voor de omslag op zowel de media als de politieke agenda. Waar media en politiek elkaar volgen en er zeker sprake is

mediatisering (Mazzoleni & Splendore, 2015, Mazzoleni & Schultz, 1999) van de politiek, blijft de toezichtagenda onafhankelijk.

3. De perceptie van governance netwerk actoren

De derde deelvraag betreft de vraag: hoe percipiëren netwerk actoren de invloed van de media in het besluitvormingsproces rondom aardbevingen?

Hoofdstuk 6 baseert zich vooral op interviews met netwerk actoren rondom het besluitvormingsproces van aardbevingen in Nederland en Italië. Drie verschillende rollen van media worden onderscheiden. Media als - democratisch forum, - agenda setter of - strategisch middel (Korthagen, 2015). Media vormen een platform voor open discussie en daarmee controle op overheidshandelen en vervullen zo de rol van democratisch forum. Media kunnen een agenda setter rol vervullen door een onderwerp aan te kaarten en daarmee de politiek alert maken op dit onderwerp. Netwerkactoren gebruiken media om informatie te delen met burgers en andere actoren en zetten daarmee media in als strategische middel. Netwerk actoren in beide landen geven aan dat media vooral verslag doen van actuele aspecten van een risico. Daarmee spelen media een democratische rol in de samenleving (Schudson, 2008), maar is de invloed als agenda setter voor de politiek in principe beperkt tot de korte termijn. Media zijn slecht in staat om een agenda setter functie te vervullen op de langere termijn beleidsagenda als zij alleen feitelijke informatie kunnen verspreiden over risico's. Met betrekking tot de mediarollen democratisch forum en strategisch middel maakt het uit of er sprake is van een disruptief (Italië) of toenemend risico (Nederland) voor hoe de verschillende actoren de rollen ervaren. Media als democratisch forum - waarin burgers besluitvormingsprocessen kunnen controleren - was afwezig in de Italiaanse situatie; mogelijk door de dominantie van de fysieke aspecten van de aardbevingen. Doordat de gevolgen van de aardbevingen dusdanig ernstig waren, richtten media zich op de dodelijke slachtoffers en fysieke schade, waardoor de rol van de overheid geen ruimte kreeg. In de Nederlandse situatie is de rol als democratisch forum voor lange tijd (voor 2013) ook afwezig maar veranderde sterk daarna. Media als strategisch middel inzetten voor het bereiken van doelstelling van de actoren zelf wordt in beide landen als lastig ervaren door netwerk actoren. De sterke focus van media op sensatie maakt het lastig om eigen doelen van actoren te communiceren, het verschil tussen de veelal technische en feitelijke communicatie van actoren en

de meer sensationele en emotionele communicatie van de media is te groot. De logica van netwerk actoren en medialogica kunnen ver uit elkaar liggen (Korthagen, 2015).

Kortom, media vervullen verschillende rollen, maar de sterke sensatie gerichte logica van media hebben volgens de governance netwerk actoren een ondermijnend effect op de beschermende en controlerende functie die de media kunnen hebben en de agendering van eventuele risico's op de lange-termijn agenda.

4. Voorbereid zijn op toekomstig risico

Tot slot, in de laatste deelvraag van het proefschrift ga ik in op de vraag: welke factoren zijn van belang voor governance actoren en –netwerken om al dan niet voorbereid te zijn op een toekomstig risico?

Net als voor deelvraag 3 baseert hoofdstuk 7 zich vooral op interviews met netwerk actoren rondom het besluitvormingsproces van aardbevingen in Nederland en Italië. Hoofdstuk 7 laat zien dat ten minste 6 potentiele psychologische besluitvorming-biases (Meyer & Kunreuther, 2017) de paraatheid van governance netwerk kunnen beperken. Het kan daarbij gaan om onvoldoende technische, sociale, economische en institutionele paraatheid. In beide landen zijn er met name sprake van institutionele hindernissen. In Nederland gaat het daarbij vooral om de grote mate van complexiteit van actoren, instituten en instituties die betrokken zijn bij de governance. In Italië gaat het vooral om bureaucratie. Fragmentatie van het netwerk en gebrek aan onderling vertrouwen spelen in beide landen een rol. In Italië komt daarbij dat er weinig geleerd wordt uit eerdere situaties terwijl catastrofale aardbevingen een oud, bekend en terugkomend fenomeen is. Dit, in combinatie met bureaucratie, zorgt mogelijk in Italië voor pessimisme om risicoreductie te realiseren. Omgekeerd, leek er Nederland een bepaald optimisme ("het zou wel mee vallen") geweest te zijn gedurende lange tijd, wat heeft geresulteerd in gebrek aan proactieve besluitvorming.

Conclusie

In dit proefschrift staat de vraag centraal: Hoe en wanneer spelen media een rol bij de sociale constructie van een risico, wat is de invloed ervan op risicobeheerprocessen van opkomende door technologie veroorzaakte aardbevingen en natuurlijke aardbevingen?

1. Risicosignalen zijn berichten over bedreiging of gevaarlijke gebeurtenissen, die de percepties van mensen beïnvloeden over hoe serieus en beheersbaar het risico is (Renn, 2009, p140). De Nederlandse aardbevingen werden lange tijd niet of nauwelijks serieus genomen ook al waren ze tot op zekere hoogte beheersbaar. Echt zware aardbevingen die de samenleving direct ontwrichten, traden niet op. Dit resulteerde in zeer beperkte media-aandacht voor de aardbevingsrisico's. En als consequentie werd in beleid, en in governance netwerken weinig tot geen actie ondernomen om de (toekomstige) risico's te beperken.

Conclusie: geen sleutelgebeurtenissen, geringe media-aandacht en lage risico paraatheid.

2. De risicosignalen over Italiaanse aardbevingen in 2009 en 2016 werden direct serieus opgepakt door de media, maar leken onbeheersbaar voor het governance netwerk. "De brute realiteit van de fysieke consequenties" domineerde, Busby & Duckett (2012) zowel de media als de governance van de risico's. Maar kort na de aardbevingen verdween de media-aandacht weer en risico governance keerde terug naar business as usual. De gebeurtenis leidde niet tot een permanente veranderde aandacht van media en beleidsvoerders voor de risicoparaatheid, de verantwoordelijkheden of de maatschappelijke conflicten.

In Nederland ontstond een heel andere situatie zonder dat er een duidelijk fysieke gebeurtenis was. Niet de aardbevingen zelf maar een rapportage van Staattoezicht op de Mijnen, waarin het risico als 'hoog' werd gekwalificeerd, zorgde voor een ommekeer in de wijze waarop gaswinning en aardbevingen in het nieuws kwamen.

Conclusie: gebeurtenissen die media activeren veroorzaken niet altijd een permanent veranderde aandacht in de berichtgeving op lange termijn.

3. Hoewel in Nederland en Italië aardbevingsrisico's al zeer lang bekend zijn, blijken in beide landen governance netwerken niet voldoende voorbereid geweest te zijn op het voorkomen, beperken of herstellen van schade van bevingen. In Nederland veranderde de situatie abrupt na 60 jaar stabiele politiek. Die omslag in de politieke discussies en besluitvorming volgde op een omslag in de aard en omvang van de berichtgeving in de

media. De omslag van media rapportages volgde op specifieke rapportages van het Staatstoezicht op de Mijnen over de aardbevingsrisico's. SodM volgde niet de media.

Conclusie: omslag punten in media beïnvloeden de agenda van de politiek, maar niet perse van het toezicht.

4. Media in Italië en Nederland brachten de aardbevingsrisico's onder de aandacht van een breed publiek. In Nederland trad dat vooral op vanaf 2013, toen logica van het risico governance netwerk samenviel met medialogica van de media. Dramatische aspecten, conflicten en andere emotionele elementen van aardbevingsrisico's hielpen de politieke besluitvorming om risico's te voorkomen of te beperken. Echter, voor 2013 zorgde medialogica er ook voor dat informatie over de risico's in Nederland niet of nauwelijks beschikbaar was buiten de provincie Groningen. En evenzeer is de keerzijde van medialogica in Italië dat nieuwsmedia vrijwel alleen aandacht schenken aan de risico's als zware aardbevingen plaatsvinden en kunnen sensationele berichten risico governance zelfs hinderen. Conclusie: medialogica is van vitaal belang voor governance van risico's, maar kan ook nadelige invloed hebben.

5. In Nederland en Italië zijn en waren governance netwerken niet optimaal in staat aardbevingsrisico's te voorkomen, te beperken of de schadelijke gevolgen te herstellen. Betrokkenen in de beide netwerken zijn van mening dat media een belangrijke rol kunnen spelen om voorbereid te zijn op de risico's. Ze zijn zelfs van mening dat die rol veel groter had kunnen zijn als de toegang voor de netwerkactoren tot media gemakkelijker zou zijn. Maar er is afstand tussen de logica van de netwerkactoren en de medialogica, die nog overbrugd zou moeten worden.

Conclusie: actoren in het governance netwerk voor risico's kunnen beter gebruik maken van media als zij bekend zijn met medialogica.

Discussie

Nieuwsmedia hebben in principe weinig tot geen aandacht voor technische aspecten van risico's van toekomstige aardbevingen. Over het algemeen is de nieuwswaarde van dergelijke onderwerpen laag

wanneer alleen informatie uit technische subdomeinen beschikbaar is. Bij gebrek aan zichtbare, gemakkelijk te herkennen gebeurtenissen, komt beschikbare technisch-wetenschappelijke risico- informatie niet overeen met de eisen van medialogica om een breed publiek tevreden te stellen. Het gevolg van geringe media-aandacht is een laag risicobewustzijn bij netwerkactoren, inclusief de politiek. Laag bewustzijn en media-aandacht stimuleren actoren en politici op het gebied van risicobeheer dan ook niet om processen te initiëren en te organiseren om toekomstige risicogebeurtenissen en hun nadelige gevolgen te voorkomen of te beperken. Wanneer de media-aandacht laag is, kan dit er zelfs toe leiden dat het governance netwerk onvoldoende is voorbereid op het risico. Hoewel media geen verantwoordelijkheid dragen voor activiteiten op het gebied van voorbereiding op toekomstig risico, kan media helpen door een geschikt platform te bieden aan netwerk actoren. A priori zijn aspecten van voorbereidheid op risico's niet interessant voor media en is de afstand tussen risicologica en medialogica groot. Maar als netwerkactoren en media erin slagen verbinding te maken en te interacteren zoals in de Groningse casus vanaf 2013, dan kan media helpen governance netwerken te helpen bij: een lange-termijn-doel realiseren, leren van eerdere gebeurtenissen, realistischer worden over de impact van activiteiten op het gebied van risicobeheer, en de verantwoordelijkheden op het gebied van risicobeheer te duiden.

Catastrofale gebeurtenissen op zichzelf lijken triggers te zijn voor media en domineren direct het nieuws. Kortdurende media aandacht is echter niet toereikend om de politieke agenda in belangrijke mate te beïnvloeden.

Een wijziging in de inhoud van mediarapportage is nodig om media een rol te laten spelen als agenda-setter in de politieke arena. Bovendien moet de uitbreiding van media-aandacht voor een langere periode duren en moet de inhoud controversiële elementen bevatten zoals besluitvorming, verantwoordelijkheid, conflicten tussen andere waarden en persoonlijke belangen. Medialogica draagt in hoge mate bij aan het voortbestaan van de controverses en conflicten, maar is niet erg geschikt om daarvoor oplossingen aan te dragen. In de Groningse casus nam de bestuurlijke complexiteit van de governance eerder toe dan af. En in de Italiaanse casus beïnvloedde media aandacht de bureaucratie niet.

Dit proefschrift voegt gedetailleerde (longitudinale) inzichten toe over de veranderende rol van media in een risicovraagstuk aan de bestaande literatuur over de interacties tussen de aard van het risico,

de rol van media, en het beleids- en politieke handelen. Media kunnen door hun aandacht en inhoud op een issue te concentreren beleid- en politieke actoren waarschuwen en beïnvloeden. Actoren uit risiconetwerken zouden media hiervoor kunnen benutten als zij goed weten in te spelen op de professionele 'eisen' die media en medialogica stellen aan nieuwswaardigheid. Maar media kunnen door hun emotie gedreven medialogica ook dusdanige druk uitoefenen op politiek en beleid dat (te) snel (te) grote beleidswijzigingen worden doorgevoerd. De brief die het kabinet op 29 maart 2018 aan de Tweede Kamer stuurde over de snelle afbouw van de gaswinning is daarvan een voorbeeld.

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Portfolio

Opperhuizen 2020:

Since 2015, Alette Opperhuizen is affiliated with the Erasmus University Rotterdam as an academic researcher. Her research focuses on the role of media in the attenuation or amplification of risk in society on the one hand, and its role in risk governance on the other.

In her work, she explored a relative new method; supervised machine learning, which is quite uncommon in the field of Public Administration. Her other work has a strong empirical and qualitative focus. Alette will defend her dissertation on 9 April 2021 at the Erasmus University Rotterdam.

In her most recent work, Alette researches the complexity of collective governance of a circular economy. In this research, she adopts a design approach to discover and overcome stakeholder challenges in the transition to a circular economy. In addition, from June 2020, she works as statistical advisor focusing on regional collaboration in the municipality of Tiel.

Occupation, education and training

2020–current	Statistical advisor focusing on regional collaboration in the municipality of Tiel.
2019–2020	Postdoctoral Researcher focusing on adopting a public design approach for a circular economy.
2016–2017	Strategic Coordinator Female Soccer at S.C. Excelsior.
2015–2020	PhD researcher focusing on media and the influence on risk governance
2010–2015	Study Public Administration, specialisation Governance of Complex System, Erasmus University, Rotterdam.
2014	Board member National Conference Public Administration, Rotterdam
2013–2014	Internship Consultancy Agency Berenschot, Utrecht.
2010	International minor Media and communication, Westminster University, London.

Conferences, events and education

- Organiser Weidse Vergezichten, Utrecht, 2019
- Complexities in process-design panel, Rotterdam, Nederland, 2019
- Society of Risk Analysis, Paper presentation on working paper: Dynamics and tipping point of issue attention in newspapers: quantitative and qualitative content analysis at sentence level in a longitudinal study using supervised machine learning and big data, New Orleans 2018.
- Society of Risk Analysis, Paper presentation on working paper: Framing a conflict! How media report on earthquake risks caused by gas drilling: A longitudinal analysis using machine learning techniques of media reporting on gas drilling from 1990 to 2015, Arlington 2017.
- International Research Society for Public Management, presentation on working paper How do media, political and regulatory agendas influence one another in high risk policy issues?, Budapest 2017
- ECPR Winter school, Course: In-depth Interviewing, Bamberg 2017
- International Research Society for Public Management, Budapest Hungary, 2017
- Course 'Depth Interviewing', European Consortium for Political Research, Bamberg 2017
- Course 'Interpretative Research', European Consortium for Political Research, Bamberg 2016
- Netherlands Institute of Government (NIG), Chair panel media and policy making, Antwerp 2015.

Publications

- Opperhuizen, A.E., & Schouten, K. (2020) Dynamics and tipping point of issue attention in newspapers: quantitative and qualitative content analysis at sentence level in a longitudinal study using supervised machine learning and big data. Quality & Quantity, (online), 1-19, doi.10.1007/s11135-020-00992-w
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- Klijn, E. H., Eshuis, J., Opperhuizen, A.E., & Boer, N. D. (2020). Blaming the bureaucrat: does perceived blame risk influence inspectors' enforcement style?. International Review of Administrative Sciences, 0020852319899433.
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- Opperhuizen, A. E., Schouten, K., & Klijn, E. H. (2019). Framing a conflict! How media report on earthquake risks caused by gas drilling: A longitudinal analysis using machine learning techniques of media reporting on gas drilling from 1990 to 2015. Journalism Studies, 20(5), 714-734.

Forthcoming/ Under review:

- Opperhuizen, A.E. (under review). Systematic biases causing underpreparedness of risk governance networks and which undermine contingencies planning practices: A double international case study on earthquake risk in Italy and The Netherlands